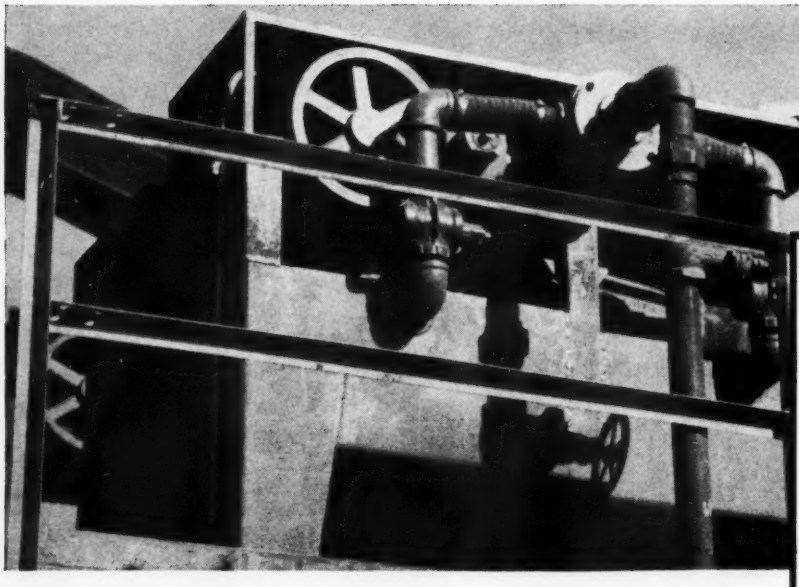
Mining CONGRESS JOURNAL

JUNE
1957

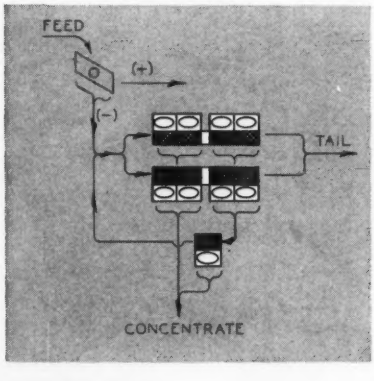
AMC COAL SHOW REPORT NUMBER



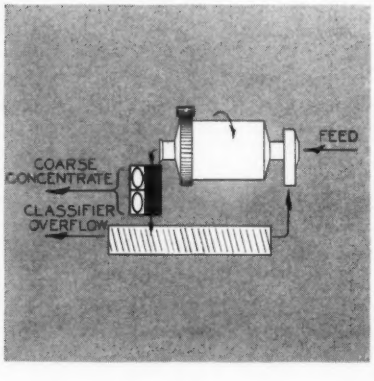
DENVER JIGS

NEW DESIGN . . . PROVEN PRINCIPLE . . .
PRACTICAL METHOD OF SELECTIVE GRAVITY CONCENTRATION

OPEN CIRCUIT



CLOSED CIRCUIT

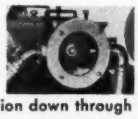


Arthur C. Daman, Jr., a graduate engineer with considerable field experience, specializes in Jig operation and is available to help solve your gravity concentration problem, recover your mineral as soon as freed. Send 20 lb. sample of your ore by parcel post for Jig test. We will have our laboratory run tests and send products to you for evaluation. No charge.

DISTINCTIVE FEATURES OF DENVER JIG

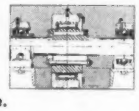
High or Low Ratio of Concentration Possible as Required

1. End Draw Off—give more efficient concentration in feeds having an appreciable quantity of + ⅛" − 5/16" material — draws off coarse size concentrate or middling product from above the screen, keeping jig bed alive and free from packing.



2. Water Valve—allows water to enter hutch to replace diaphragm displacement on the upward stroke. Gives true hindered settling because suction down through bed is eliminated. Minimizes water consumption. Adds flexibility and selectivity to jig.

3. Denver Dowsett Valve — provides automatic discharge of the hutch product without disturbing the jigging action and also reduces water consumption when ratio of concentration is low.



4. Roller Bearing Eccentrics—reduces friction and puts more trouble free service at the point of greatest wear—assures continuous 24 hour service.

5. Sturdy Construction — heavy steel plate is used on frame, legs, tank and hutch compartment. All seams double welded. Minimum floor space is used.

6. Simple Stroke Adjustment—permits easy variation of the length of stroke. The operator can easily change jigging action to get maximum recovery at all times.

7. QUICK DELIVERY

SIMPLEX

DUPLEX

"The firm that makes its friends happier, healthier and wealthier"

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Mining

CONGRESS JOURNAL

JUNE, 1957

VOLUME 43 NUMBER 6

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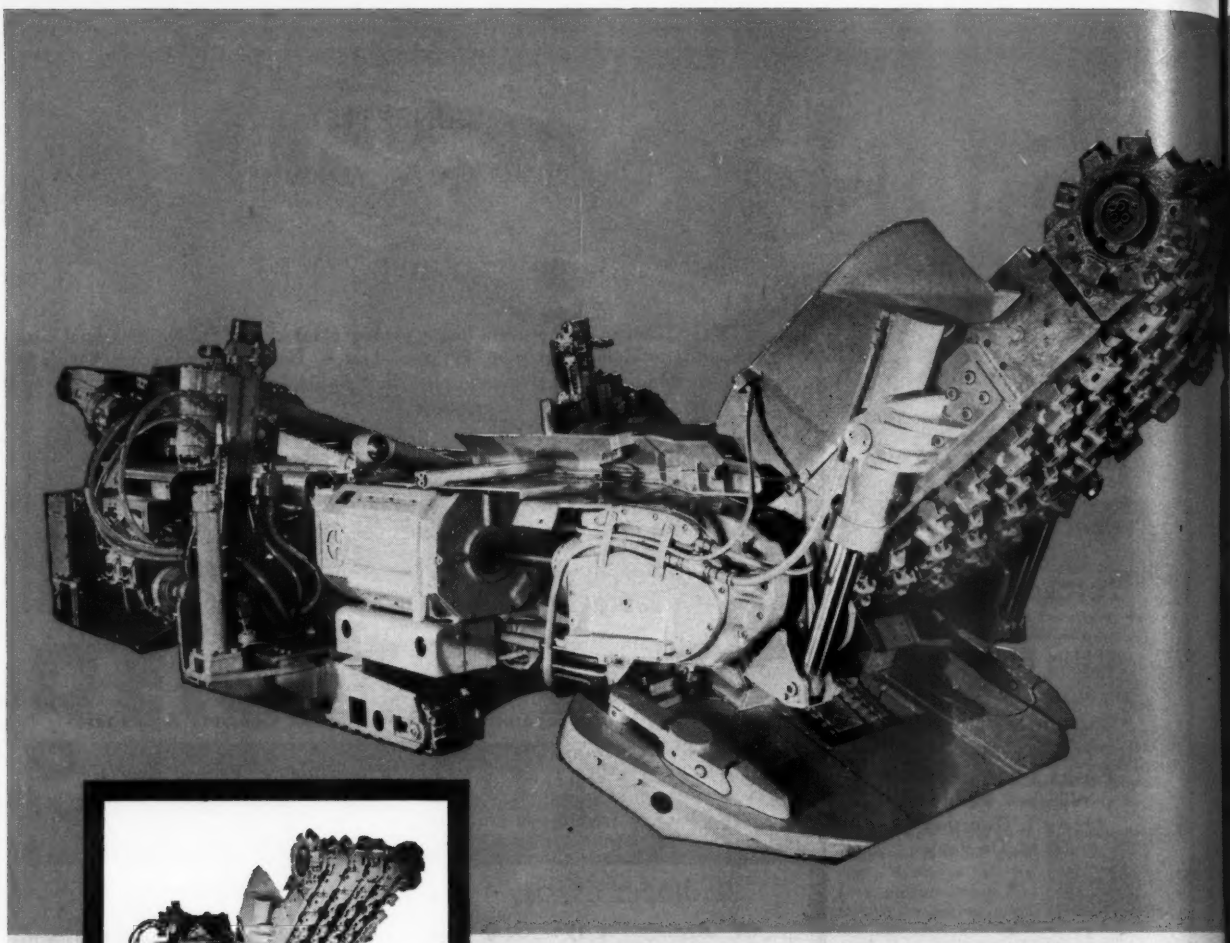
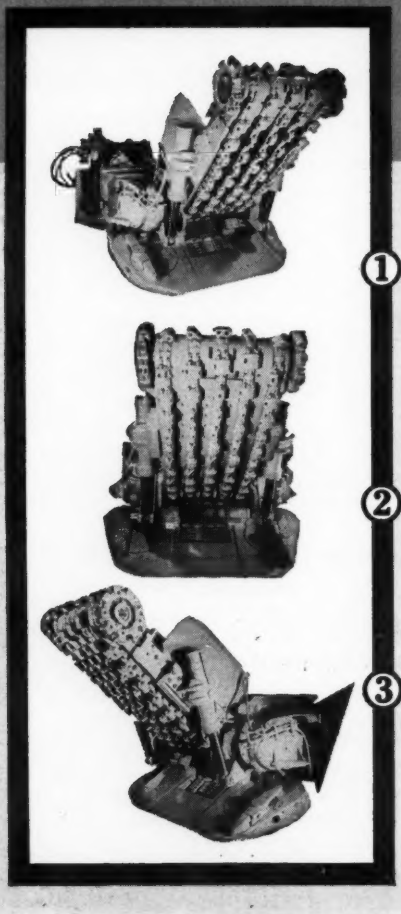




1 GATHERING ARM CLEAN-UP

The rugged clean-up works on the same proven principle as Joy Loaders . . . speeds up pillar extraction. The operator can clean up old workings, rooms, and crosscuts . . . in an 18′ room, the miner can clean up the entire bottom to within 8″ of rib.

2 EXTRA LARGE RIPPER HEAD

The 42″ wide ripper head with extra deep sump (increased to 21″) results in greatly increased tonnages. The new head also results in more ripped coal and less fine coal.

3 DIRECT ACTING SHEAR JACKS

More powerful shear jacks easily maneuver the extra large ripper head. These jacks eliminate chains and linkages; reduce maintenance. Jacks are inverted . . . keeps dust from cylinders.

25% Higher Tonnage

The New JOY 1CM-3 Miner

Produces 4½ Tons Per Minute

THESE

NEW FEATURES

MAKE IT POSSIBLE

21" SUMP

GATHERING ARM CLEAN-UP

42" WIDE RIPPER HEAD
DIRECT ACTING SHEAR JACKS

INCREASED POWER
250 HP STANDARD
276 HP WITH ROOF DRILLS

WRITE FOR

BULLETIN

182-3

The new Joy 1CM-3 is a 47" high continuous miner for driving entries, mining rooms and extracting pillars, in seams 60" and higher. It is an entirely new machine with every new feature engineered into it as a result of Joy's long experience in the continuous miner field. It has the power to produce up to 4½ tons per minute.

Less time is involved in clean-up operations because of a completely new clean-up design that works on the gathering-arm principle. The new clean-up handles draw slate and old workings.

Find out how the new 1CM-3 will fit into your operations . . . write ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

JOY EQUIPMENT FOR MINING . . . FOR ALL INDUSTRY

CONTINUOUS MINERS

LOADERS

DRILLS

CUTTERS

WSW CL 6682-182

How Bethlehem trackwork speeds haulage

This smoothly-operating haulage system didn't just grow that way. It was carefully planned in advance to meet the specific needs of the mine, both for the present and for the foreseeable future. And the experienced touch of Bethlehem engineering is clearly evident throughout the layout.

For example all the rail is heavy stuff that will stand up under the pounding of peak traffic loads. All curves are smoothly eased, all tangent sections are truly straight, to permit top speeds without derailment or spillage.

Turnouts and crossings were tailor-made to fit precisely into their allotted spots, and are ruggedly built for the tough grind of high-speed operation. All switch stands, guard rails and other accessories are husky, absolutely dependable and trouble-free.

If all this is beginning to sound a bit luxurious to you, we'd like to clear the air on that point now. Superb as it is, a Bethlehem layout actually costs but a pittance in the long run because of the operating economies it allows.

A Bethlehem engineer would like to sit down with you and discuss whatever revamping or expansion you may have in mind. A meeting can readily be arranged to fit your schedule. Simply place a call or drop a line to the Bethlehem office nearest you.

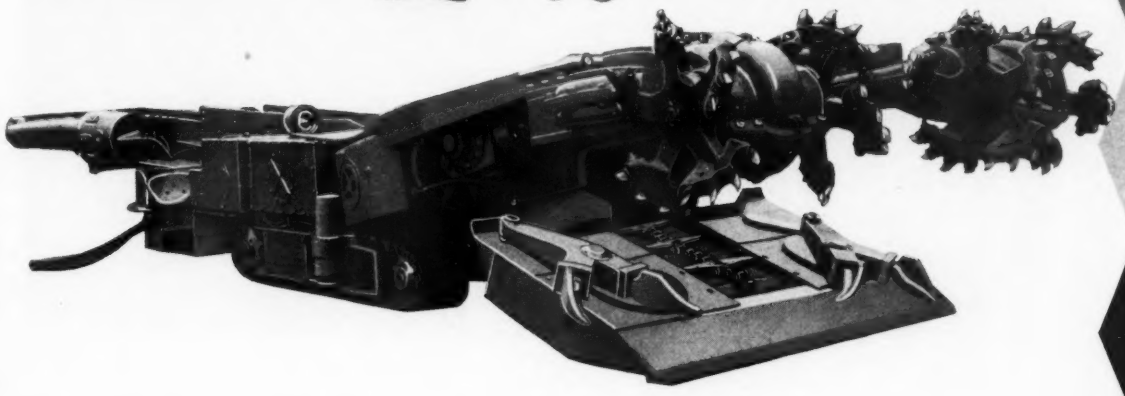
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

HERE'S WHY THOSE WHO KNOW PREFER THE *Lee-Norse* MINER



PATTERN CUTTING—*only Lee-Norse has it.*

CUTS MORE COAL WITH LESS POWER . . . *cutters revolve and oscillate at the same time—milling the coal from the face.*

CUTS A COARSE PRODUCT–FEWER FINES . . . *cutter bits follow a right and left spiral direction producing a diamond pattern which breaks off in coarse cuttings.*

A SIMPLE, STURDY MACHINE . . . *essentially a modern loading machine on which is mounted a set of efficient cutting heads.*

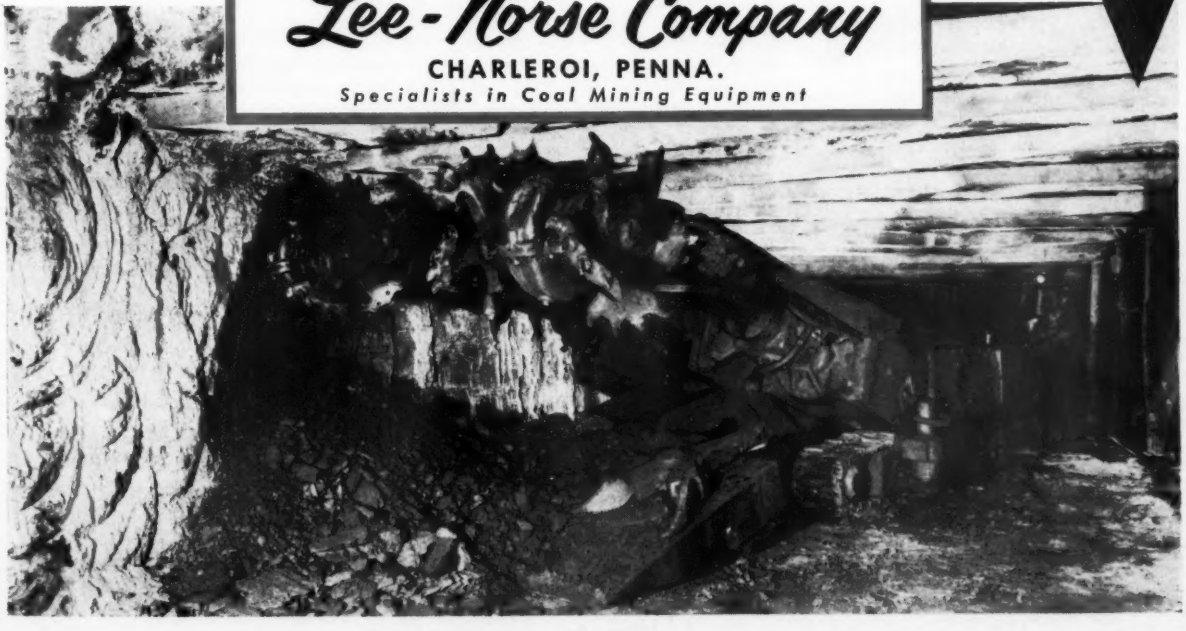
HIGHLY MANEUVERABLE–FAST TRAMMING. . . *not a "muscle-bound giant" . . . it quickly follows any variation in seam thickness.*

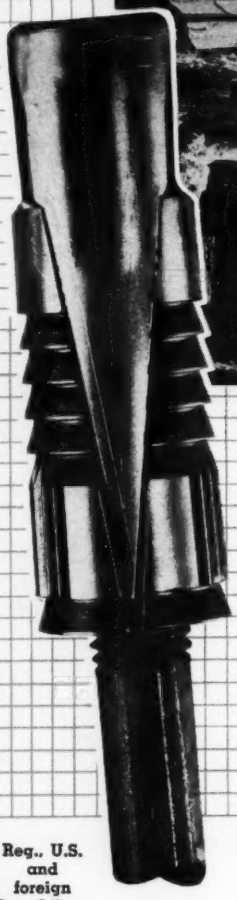
EXCELLENT CLEAN-UP . . . *improved dual gathering arms load all the coal into a flexible rear conveyor.*

Lee-Norse Company

CHARLEROI, PENNA.

Specialists in Coal Mining Equipment





Reg., U.S. and foreign Pat. Offices

In Western States

PATTIN expansion shells are available and serviced exclusively through Colorado Fuel and Iron Corporation, Denver, Colorado. Western mining companies may contact them indirect for information and consultation.

Most mines can Roof Bolt

Effectively and Profitably . . . .

WHILE each mine may be different in physical characteristics, in method of operation or types of equipment used—all mines have one problem in common—the problem of keeping the roof in place.

Hundreds of mines, with all different kinds of roofs, have proved that roof bolting is the best form of roof control. They have also found that bolting leads to increased safety, better ventilation and greater production efficiency. Roof bolting offers so many profitable production advantages it justifies any mine, now using conventional timbering methods, making comparative roof support tests. Bolting tests can be made at very little cost.

To be as effective as possible—roof bolting calls for thorough knowledge of the roof strata—well planned bolting patterns and cycles—proper selection of bolts and shells—and adequate supply and service program. Being "The Pioneer in Roof Bolting" —PATTIN MFG. COMPANY, staffed with experienced roof bolting, mining engineers, is capable of meeting every requirement for quality products and service. Your phone call or letter will get immediate attention.

Shown above is the outstanding PATTIN style D-1 expansion shell. Samples of the "D-1" or "D-2" shells will be furnished upon request.

PATTIN MANUFACTURING COMPANY

"69th Year"

MARIETTA, OHIO

always on the job

That's a benefit more and more mining operators experience with their Macks. They know that Macks keep going 'round the clock . . . taking the steepest grades and roughest terrain in stride . . . always hauling extra-capacity loads . . . with time out for only routine servicing and maintenance.

Mack off-highway dumpers—four basic models with rated capacities from 15 to 34 tons—are built for enduring performance. Mack or stock diesel engines ranging from 170 to 400 hp, all delivering maximum torque at low r.p.m. . . . famous Mack transmissions with two-speed compounds or torque converters . . . exclusive two- and four-wheel rear-axle drives with planetary gear reduction in the wheel hubs to provide smooth power transfer without excessively large gears in the carriers . . . Mack's unique Balanced Bogie with Power Divider, the four-wheel, rear-axle drive that delivers maximum power to the wheels with traction . . . off-set cabs designed for maximum visibility and driver efficiency . . . these and many more features make Mack the performance and economy leader of the industry.

Why not join the swing to Macks—the swing that means maximum hauling efficiency at minimum unit costs for so many operators. Contact your Mack representative for full details and specifications. Mack Trucks, Inc., Plainfield, New Jersey. In Canada: Mack Trucks of Canada, Ltd.

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American Cyanamid... serving you with plants and magazines in major coal-mining areas!

An important aspect of American Cyanamid's *complete* service to its customers is its ability to fill their orders promptly and efficiently. This is made possible by Cyanamid's network of thirty-two magazines and plants, each located where it can render quick service to a major coal-mining district.

Another phase of this service is the readiness of American Cyanamid's representatives to give you expert assistance on any unusual blasting problem.

THE CYANAMID EXPLOSIVES LINE

High Explosives	Electric Blasting Caps
Permissibles	Instantaneous
Blasting Powder	Regular Delay
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How to boost pit output... cut handling costs

Short turn radius of Rear-Dumps allows quick spotting in restricted areas. Low rear-entry and wide bowl provide easy target for shovel operator . . . make for fast dipper swing-out, let shovel operator heap maximum yardage without spillage.

The use of modern LeTourneau-Westinghouse Tournapull Rear-Dumps on your pit hauls can cut cycle time, boost production, and lower operating costs. Here's how:

Greater maneuverability — Positive electric power steer, through geared kingpin, permits prime-mover to pivot at right angles for short 90° turns. As a result, unit makes continuous U-turn in less space than Rear-Dump's own length. In dump position, it turns in only about ⅔ of overall length!

There's no need for turntables or elaborate turn-around areas. You spot faster at the shovel, dump faster, and get away faster from pit or dump. On the haul, you make hairpin turns with safety — complete cycles faster. Time saved adds up to extra trips per shift, greater production . . . with no increase in manpower or equipment investment.

Speeds loading — Low, wide bowl permits shovel bucket to swing in low for faster loading. It permits quick bucket swing-out, even while dipper-door is still open. And because of large target area, spillage is greatly reduced. Production delay during the day for clean-up of pit floor is minimized.

Dumps fast, clean — Flick of switch on control panel instantly activates point-of-action electric-hoist motor. Body raises quickly, to desired angle. At full dump position, edge of bowl is low behind rear wheels . . . material cannot roll forward to lodge against wheels, nor pile under rear end. Streamlined body sheds stickiest material readily.

Resists body shock, damage — Shovel operator does not have to take it slow and easy when loading. Rear-Dump body is ruggedly built. Simplicity of Tournapull Rear-Dump construction permits using steel otherwise used in frame and sub-frame. In L-W Rear-Dumps this material is used to build greater strength into the bowl itself. Body is all steel — no wood fillers. Floor is lined with heat-treated tool-steel strips, welded to solid billets laid over heavy steel plate.

Ask for complete information

If you're interested in increased production and lower handling costs, it will pay you to investigate high-production Tournapull Rear-Dumps. 3 sizes: 11, 22, and 35 tons. Write for full specifications.

Tournapull—Trademark Reg. U.S. Pat. Off. R-1452-M-1

Big single, low-pressure tires . . . exclusive power-transfer differential . . . and 90° electric wagon-type power steer enables Rear-Dump to safely and steadily haul through muck, rock, and soft fill.

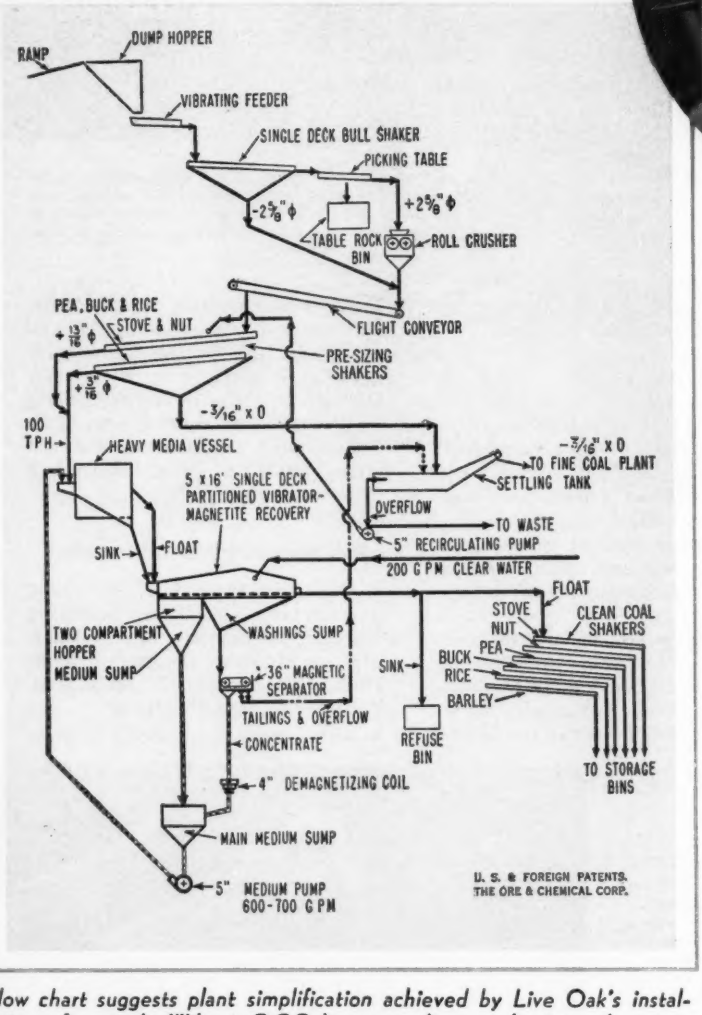
LeTourneau-WESTINGHOUSE Company, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

WHERE QUALITY IS A HABIT

IMPROVES COMPETITIVE POSITION WITH 'WILMOT-OCC' HM VESSEL

ELIMINATING MULTIPLE CLEANERS SIMPLIFIES PLANT CIRCUITS



Flow chart suggests plant simplification achieved by Live Oak's installation of a single Wilmot-OCC heavy-media vessel, pictured at top.

Live Oak Coal Co. Feeds a Wide Range of Sizes to a Single Heavy-Media Vessel

The flow chart at left offers a graphic example of how Wilmot-OCC heavy-media vessels are cutting production costs. Note how Live Oak Coal Co., by installing one vessel, eliminated several cleaners, numerous conveyors, screens and other equipment. In addition to savings in both operating and maintenance labor, the company effected substantial improvements in yield and product quality. Their vessel's performance figures show less than 1% of misplaced material and a loss of less than ¼ lb. of magnetite per ton of raw coal. The owners of Live Oak feel that their modernization program has clearly achieved the desired goal:- To insure their place in the market.

SEND FOR BULLETIN and reprint of the Live Oak story in a leading mining magazine.

WILMOT

WILMOT ENGINEERING CO.

HUNTINGTON, W. VA.: PO Box 1831, Phone JAckson 5-2571

WHITE HAVEN, PA.
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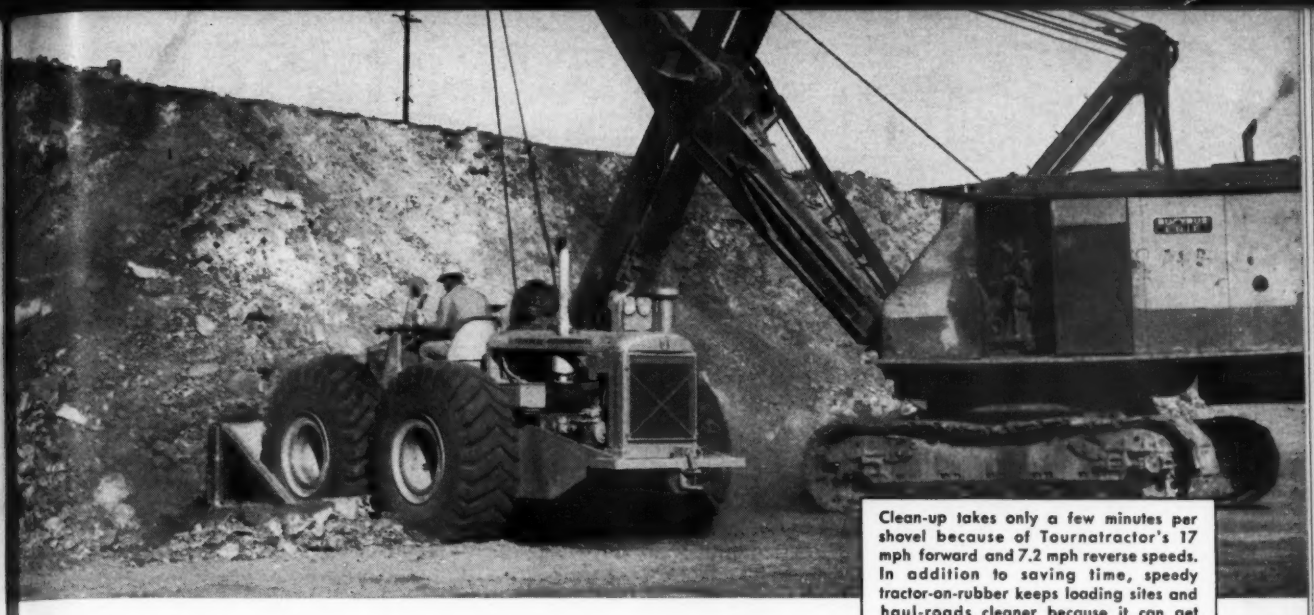


Clean-up takes only a few minutes per shovel because of Tournatractor's 17 mph forward and 7.2 mph reverse speeds. In addition to saving time, speedy tractor-on-rubber keeps loading sites and haul-roads cleaner because it can get around to each shovel more times per day than a crawler-tractor.

Rubber-tired tractor

speeds clean-up around 3 shovels

1 fast machine replaces 2 crawler-tractors

Working their Eagle Mountain Iron Mine, Eagle Mountain, California, Kaiser Steel Corp. find they get more clean-up work done faster with 1 Model C Tournatractor than if they assigned 2 crawler-tractors to handle the same job. The new tractor-on-rubber replaced one full-time crawler, and does the part-time plant and pit-maintenance work formerly assigned to a second track-type machine. The change to the faster, more maneuverable 210 hp Tournatractor enables the mine to keep haul units moving with less delays due to spillage or uneven pit floors.

3 to 4 times faster than crawlers

Tournatractor handles all clean-up assignments around 3 shovels. It shuttles back and forth at speeds up to 17 mph, which is 2 to 3 times faster than the top speed of most crawlers. In addition, reverse speeds to 7.2 mph allow unit to back away quickly without interfering with loading operations. Big, 21.00 x 25 low-pressure tires provide plenty of flotation and traction. They stand up well despite abrasive and rocky footing around pit floor.

Also used for pulling and pushing

In addition to clean-up and bulldozing, the 210 hp tractor pulls air compressors to drilling sites and moves the frame supports which carry electric cable for shovels, drills, and other equipment.

Get all the facts

Owners around the world are taking advantage of the ease of maintenance, durability, speed, and high production of the Tournatractor. If you are interested in these same benefits for your pit, get all the details from your Distributor today.

Tournatractor—Trademark Reg. U.S. Pat. Off. CT-1548-M-1

Tournatractor also cuts downtime for air compressors and other equipment when moving them from one location to another. Tournatractor gets on the job quicker...gets to the next assignment quicker. 1500 ft. is less than a minute away.

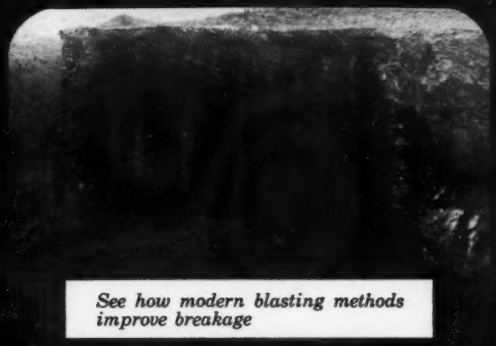
LeTourneau-WESTINGHOUSE Company, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

WHERE QUALITY IS A HABIT

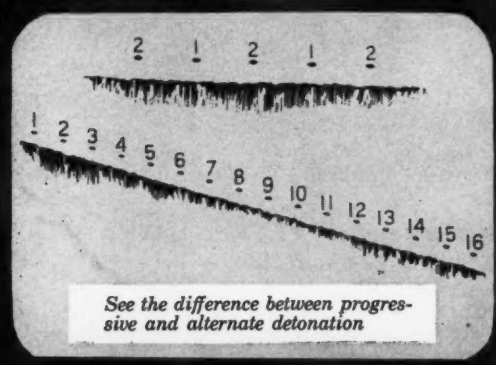
TO HELP YOU BLAST WITH GREATER ECONOMY

The INSIDE STORY



See how modern blasting methods improve breakage

See how the point of initiation affects rock movements...controls throw



See the difference between progressive and alternate detonation

Don't miss this movie for men who use explosives in Quarries, Strippings and Construction!

Here is a motion picture that gives the facts on modern blasting techniques. It shows how you can save money through better, more complete fragmentation . . . how you can increase safety by eliminating the need for secondary blasting . . . and how your public relations can be improved by holding noise and vibration to a minimum.

"*The Inside Story*" is prepared by Atlas Powder Company as a technical service. Show it to your organization for a better understanding of scientific blasting. It explains in detail how the point of initiation affects blasting results . . . how millisecond delay techniques and alternate velocity loading are used to gain maximum efficiency.

This information also makes "*The Inside Story*" well suited for showing at institute meetings and to other engineering groups.

How to get the film. Simply write us on your letterhead, telling us at what type of meeting you'd like to show "*The Inside Story,*" and approximately when you'll need it. We'll try to ship a print to you well in advance of the date you select.

Ask also about other Atlas educational material such as the films, "*How to Handle Women and Explosives*" (for your safety meetings), and "*We're Blasting Near You*" (to show to your neighbors). And write for "*Better Blasting,*" the informative Atlas newsletter on latest blasting materials and methods.

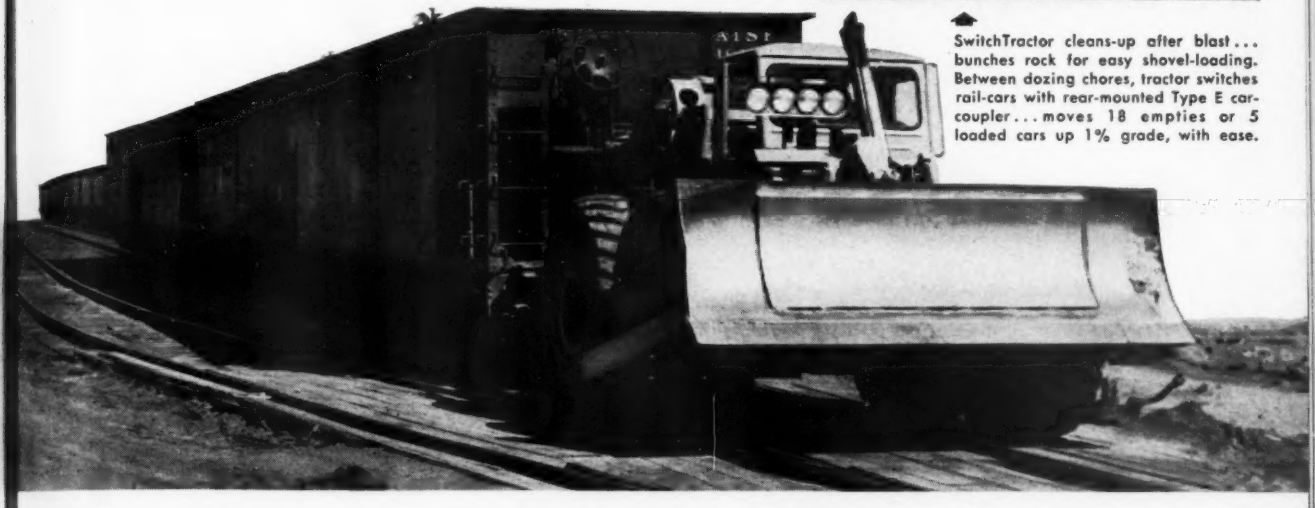
EXPLOSIVES DIVISION

ATLAS POWDER COMPANY

WILMINGTON 99, DELAWARE

offices in principal cities

Double-duty tractor



SwitchTractor cleans-up after blast... bunches rock for easy shovel-loading. Between dozing chores, tractor switches rail-cars with rear-mounted Type E car-coupler... moves 18 empties or 5 loaded cars up 1% grade, with ease.

SwitchTractor moves rail-cars, does regular tractor work

Here's a big, 208 hp rubber-tired tractor that does double-duty by also switching railroad cars. With its 17 mph speed, and go-anywhere mobility, SwitchTractor works fast ... often switching "for free" in spare time between tractor chores.

Tournatractor with car-coupler

Cost-cutting SwitchTractor is a regular LeTourneau-Westinghouse Tournatractor—fitted for operation of dozer, angledozer, snow plow, and other attachments. In addition, it is equipped with a standard Type E railway coupler attached on the rear. SwitchTractor can either *pull* a string of cars with its coupler... or *push* them with dozer blade; can safely spot or "hump" cars on many widely scattered tracks in a minimum of time.

Switch-engine, not tied to tracks

This 208 hp go-anywhere switcher-dozer is always ready to shift rail-cars wherever needed. Rolling on big rubber tires, it maneuvers quickly from spur to spur... moves back and forth between pit, bench, stock-pile, plant, dump, or other location. It travels via roads or cross-country ... always takes the fastest route.

When switching cars, SwitchTractor straddles the rails (6'4" between tires), rolls on tie-ends and ballast. It gets better traction, can *pull twice as many cars* as an on-track switcher of the same weight. Big, low-pressure tires do not damage ties, rails, switches, or pavement.

Saves time on tractor work

Double-duty SwitchTractor also dozes, pulls, and pushes faster than crawlers. Practical work-speeds to 7.5 mph, and top-speed of 17.2 mph, let you handle more plant clean-up and pit maintenance. You build and keep haul roads smoother, open snowed-in roads earlier. You handle shovel clean-up promptly and effectively, spread waste on dumps faster, move utility equipment easier.

On push-and-return work SwitchTractor's constant-mesh transmission with air-actuated clutches, alone, gives you up to 8 minutes extra production per hour. It saves up to 5 seconds, each gear-shift... makes no stops for shifting, loses no momentum... changes direction or gear-ratios *instantly*. In addition, torque-converter (standard equipment) provides uniform and most effective engine speed — with automatic rationing of wheel speed to load — for maximum efficiency in application of power.

Go-anywhere mobility widens work-range

Because 17 mph SwitchTractor *travels job-to-job twice as fast* as crawlers, it works more productive hours per day... services more pit operations, gets to work faster, handles more work over a wider range of travel. It requires no special planking for moves... no flatbed-hauler, trucks, and extra help.

This rubber-tired L-W SwitchTractor is a two-way money-saver for mine, quarry, or pit. Call or write for complete details and prices.

SwitchTractor—Trademark; Tournatractor—Trademark Reg. U.S. Pat. Off. ST-1355-M-b

LeTourneau-WESTINGHOUSE Company, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

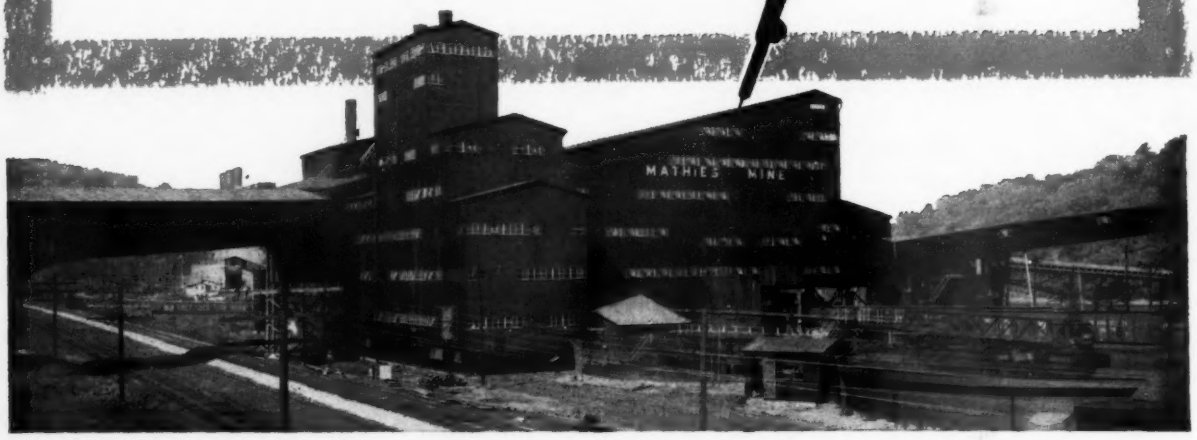
WHERE QUALITY IS A HABIT

PREPARATION PERFORMANCE

preceded by

60

Successful Years . . .



A **FAIRMONT** -built Preparation Plant

is in a class all by itself

YOURS: All the modern developments plus all the exclusive advantages of **FAIRMONT** -engineering and **FAIRMONT** -construction

FAIRMONT MACHINERY COMPANY

FAIRMONT, WEST VIRGINIA

DESIGNERS AND CONSTRUCTORS OF COMPLETE COAL PREPARATION PLANTS USING BOTH WET AND DRY CLEANING, CENTRIFUGAL AND THERMAL DRYING.

Rubber-tired haul units reduce maintenance costs at South African pits

●

Find out how you, too, can Cut Costs . . . Increase Profits

Two self-powered D Tournapull-Scrapers handle all special sand mined from two valuable pits owned by Industrial Sand & Engineering Co., Ltd., Pretoria, Union of South Africa. These two pits, 15 miles west of Pretoria, in Moot Valley, produce 75% of all the sand used in South Africa's glass and foundry industries.

Haul 14,060 metric tons a month

Working 45 hours per week, the two Tournapulls move about 15,500 tons of glass sand (silica), foundry sand, and overburden every month.

In typical operation, "D's" self-load an average of 6 cubic yards of moist foundry sand in ½ minute. Hauls of about .2 mile, to the grizzlies located at each pit, take 1½ minutes. Each of the D Tournapulls completes a typical cycle of more than .8 mile in 4.4 minutes.

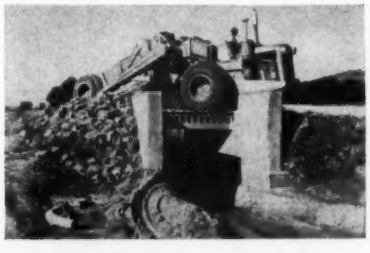
Handle maintenance, construction

This high production rate is partly due to the good condition of the sand haul roads, maintained and compacted by the versatile Tournapull Scrapers themselves.

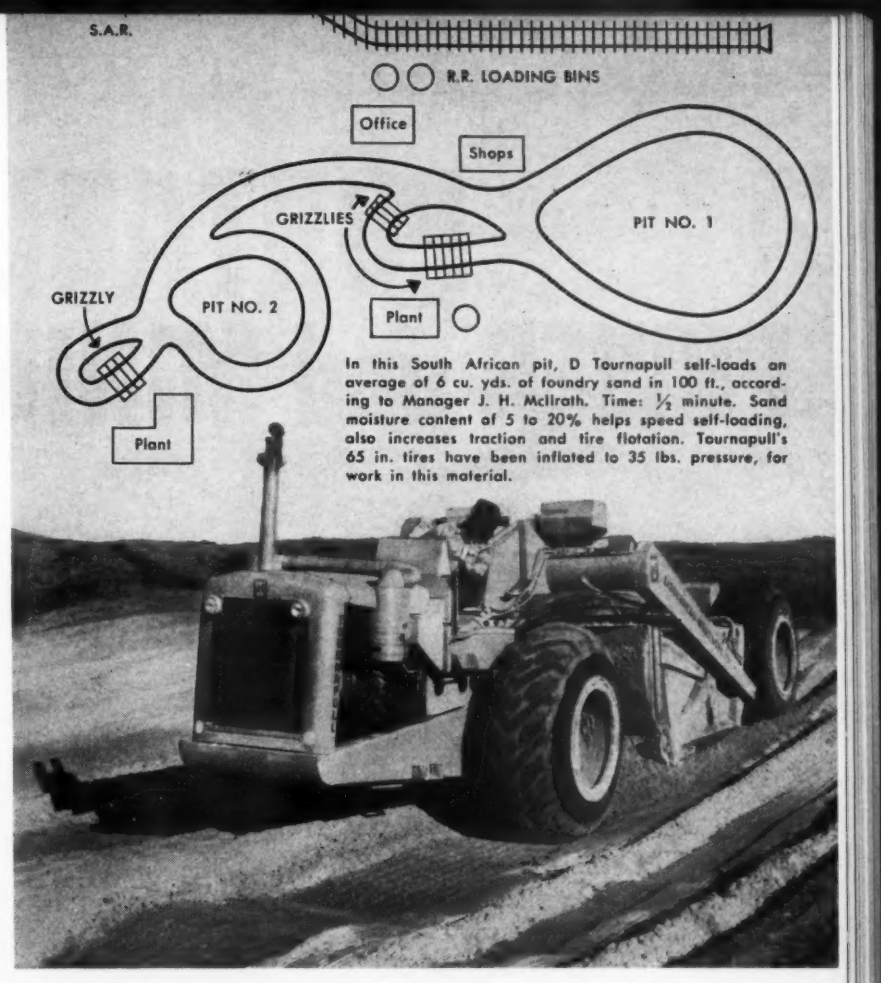
Due to their fast, efficient sand-moving, Tournapulls have plenty of time for such road maintenance, in addition to their regular mine hauling duties. In their spare time, Tournapulls are also assigned to build dams where necessary, and to act as utility hauling tools.

Company formerly used 57 hp crawler-tractors and scrapers to haul the abrasive sand at these two pits. Maintenance and repair costs, however, ran excessively high on track-type haul units. Pins and bushings had to be replaced after every 400 hours of use.

In sharp contrast, Tournapull tires are giving more than 3,000 hours of use, working in material that representatives for the crawler manufacturer called the "most abrasive" they ever encountered.



Tournapull dumps load of special moist sand into grizzly in an average of 18 seconds. Industrial Sand & Engineering Company mines only top grade glass and foundry sand at the company's two pits in Moot Valley.



In this South African pit, D Tournapull self-loads an average of 6 cu. yds. of foundry sand in 100 ft., according to Manager J. H. McIlrath. Time: ½ minute. Sand moisture content of 5 to 20% helps speed self-loading, also increases traction and tire flotation. Tournapull's 65 in. tires have been inflated to 35 lbs. pressure, for work in this material.

"It was a lucky day when we purchased the Tournapulls," says Manager J. H. McIlrath. "We were getting only 400 hours of track life."

Liked one, bought another

For an entire year, a single Tournapull mined all sand handled here, and hauled it to the washing plant. When company officials decided to add a second haul unit, they showed their satisfaction with Tournapull performance by purchasing a second "D".

The same high-speed mobility, and low maintenance that contribute to Tournapull efficiency in this successful mining work could benefit *your* projects, too. Before you buy another set of tracks, investigate the many advantages that rubber-tired Tournapulls can give you. Write us for more information.

Tournapull—Trademark Reg. U.S. Pat. Off. DP-1187-S-b

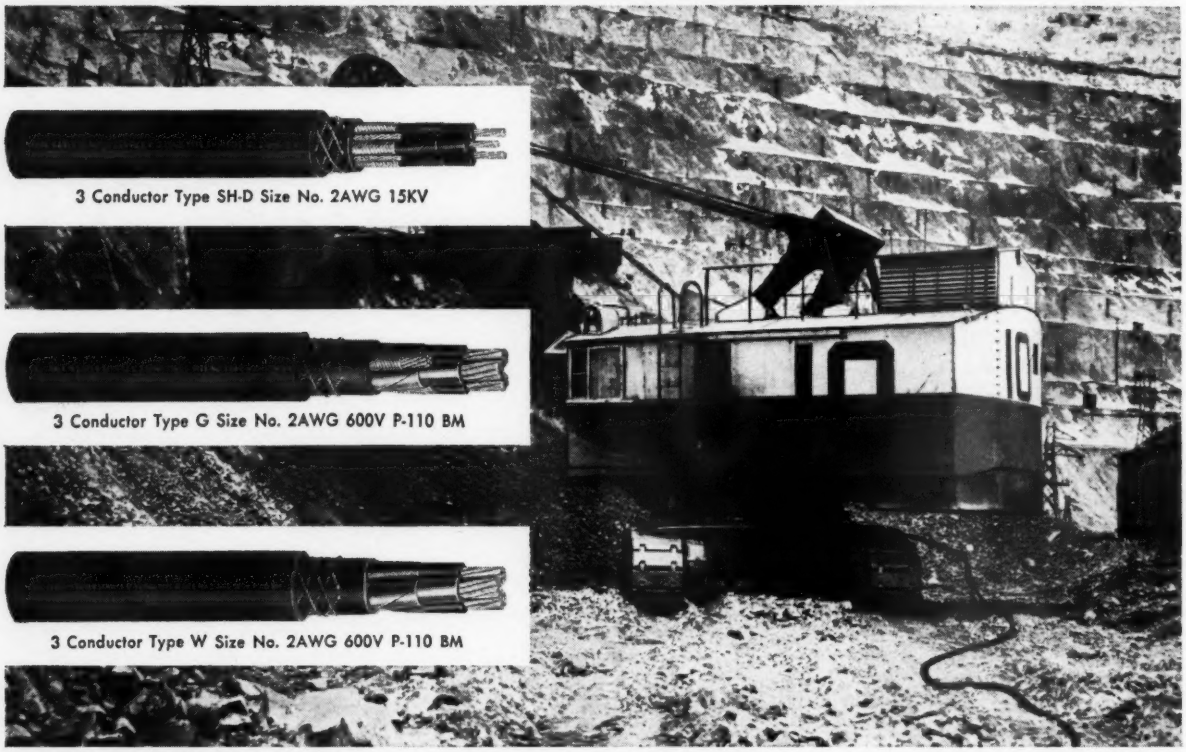
LeTourneau-WESTINGHOUSE Company, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

WHERE QUALITY IS A HABIT

GENERAL CABLE SUPER SERVICE

PORTABLE POWER and MINING CABLE


3 Conductor Type SH-D Size No. 2AWG 15KV
3 Conductor Type G Size No. 2AWG 600V P-110 BM
3 Conductor Type W Size No. 2AWG 600V P-110 BM

with SUPERTUF Jacket

GENERAL CABLE offers a complete line of SUPER SERVICE portable power and mining cables which will stand up under the most severe operating conditions and furnish longer life and reliable service no matter how difficult the application.

All SUPER SERVICE cables are jacketed with an extra heavy duty, vulcanized in mold, double layer cord reinforced "SUPERTUF" neoprene sheath with maximum resistance to tearing, cutting, abrasion and overall mechanical abuse, and possessing outstanding resistance to water, oil, acids, alkalis, flame and effects of sunlight and weathering.

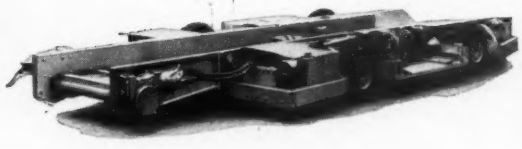
SUPERTUF neoprene jacket far exceeds the requirements of ASTM D-752, and all 600 volt SUPER SERVICE portable cables bear the official approval number P-110 BM embossed in the jacket indicating compliance with the flame resistance requirements of the Pennsylvania Department of Mines and requirements of the Federal Bureau of Mines.

GENERAL CABLE CORPORATION, 420 Lexington Avenue, New York 17, New York
Offices and Distribution Centers Coast-to-Coast

for quality and service . . . **specify GENERAL CABLE**

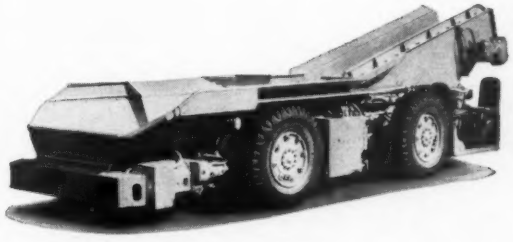
More round trips per shift and bigger payloads with **JEFFREY SHUTTLE CARS**

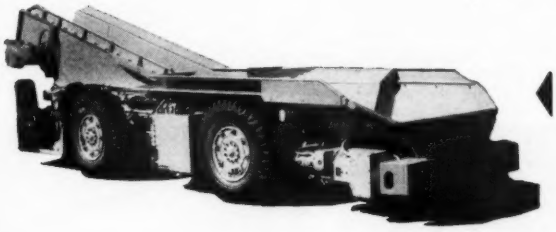
Class 68 Shuttle Car—heights from 24 to 32 inches; capacities from 2.4 to 3.9 tons; average speed 3.2 MPH fully loaded, 3.5 MPH empty. Though having a low basic height, it embodies all features of design and operation found in higher cars.



Class 66 Shuttle Car—heights from 30 to 48 inches; capacities from 2.7 to 6.1 tons; average speed 4 MPH fully loaded, 5 MPH empty. 66A in basic heights of 30" or 36" with maximum of 42" using sideboards. 66B in basic heights of 36" or 42" with maximum of 48".

Class 67 Shuttle Car—heights from 44 to 60 inches; capacities from 4.6 to 9.2 tons; 88" or 96" wide; average speed 4.2 MPH fully loaded, 4.9 MPH empty. 67A in basic height of 44" with maximum of 55" with sideboards. 67B in basic heights of 48" or 54" with maximum of 60".





Class 90 Shuttle Car—low cost, heavy duty . . . carries up to 8 tons. Trams at an average of more than 4 MPH. Unloads in less than a minute. 44" and 50" basic heights with 4", 6" or 8" sideboards.

Four-wheel drive with no-slip differential between wheels on the same axle . . . four-wheel steering . . . four-wheel disc type hydraulic brakes . . . full magnetic, progressive series-parallel acceleration with hand-selection series position; all add up to account for the high degree of maneuverability offered by Jeffrey shuttle cars.

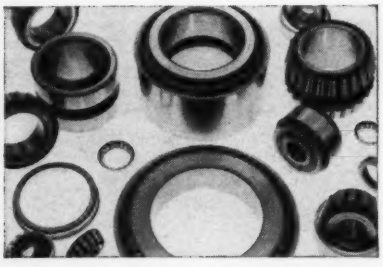
Loading and unloading are fast, because the operator has the aid of the variable speed, hydraulically driven discharge conveyor. It can be reversed instantly to clear jammed lumps. Jeffrey shuttle car payloads can be matched to your mining height.

[*Page 17*]

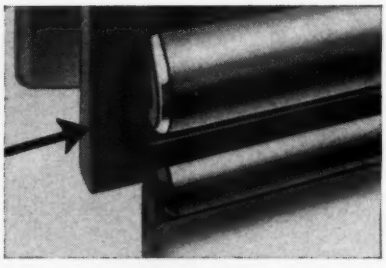
JEFFREY

THE JEFFREY MANUFACTURING COMPANY
958 North Fourth Street • Columbus 16, Ohio

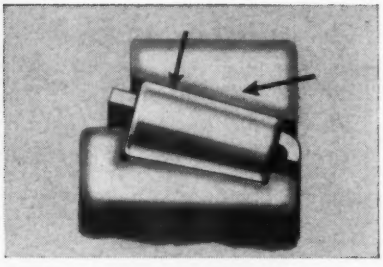
Get all these advantages . . . specify TIMKEN® tapered roller bearings



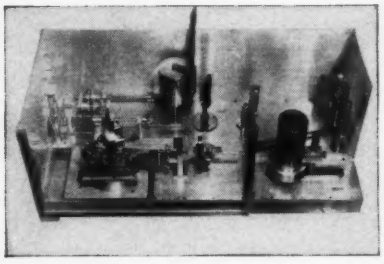
THERE ARE 27 TYPES of Timken® tapered roller bearings. This wide selection means you get the bearing design exactly suited to your job. Whatever your bearing application problem, we can help solve it.



THE SOFT STEEL CAGE used in Timken tapered roller bearings separates the rollers, keeping them spaced evenly. This prevents scuffing of the rollers, adds to the bearing life and gives you more for your money.

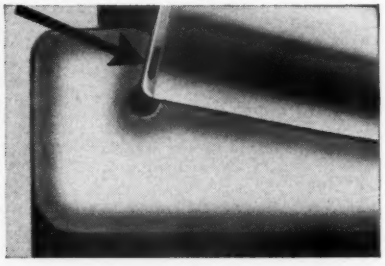


HARD ON THE OUTSIDE, tough on the inside. To take shock loads, give longer life, Timken bearing rollers and races are case-carburized to have a hard, wear-resistant surface over a tough, shock-resistant core.

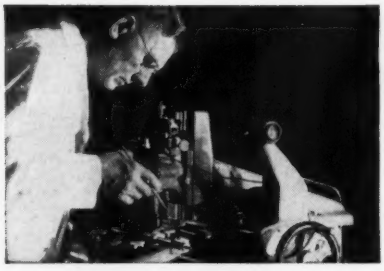


MICRO-INCH FINISH is standard for Timken bearings. This profilograph checks contours and smoothness of circular surfaces to a millionth of an inch, helps us make Timken bearings truer, quieter, longer-wearing.

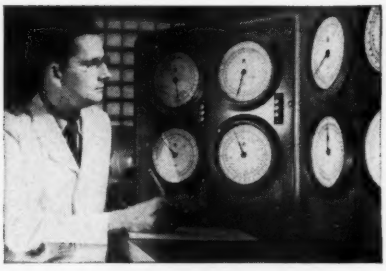
6,525 SIZES, the world's largest selection of tapered roller bearings. From bearings smaller than your finger to 71½" in inside diameter, the Timken Company can supply the size you need for any specific application.



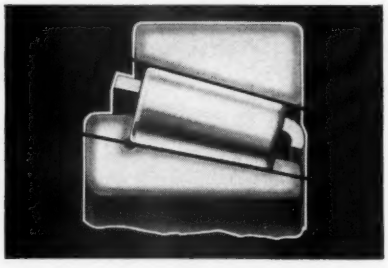
POSITIVE ROLLER ALIGNMENT is assured because the taper in Timken bearings holds ends of rollers snug against the rib. The taper in Timken bearings lets them take radial or thrust loads or any combination.



ACCURATE TO 50 MILLIONTHS of an inch. This Universal Measuring Machine checks gages and machine parts used to make Timken bearings. Our gage laboratory, one of the world's best equipped, helps make Timken tapered roller bearings your No. 1 bearing value.



WE MAKE OUR OWN FINE ALLOY STEEL. No other American bearing maker does. This spectrometer helps control steel quality—in 40 seconds gives the exact chemical analysis of a melt. In a few minutes, results are flashed to the melter. It's another step in rigid quality control.



FULL LINE OF CONTACT between Timken bearings' rollers and races gives them *extra* load-carrying capacity. To get *all* these advantages, specify "Timken". The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

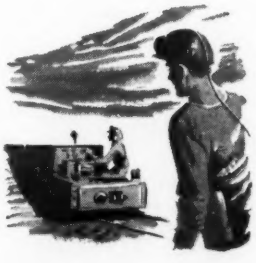
TAPERED ROLLER BEARINGS ROLL THE LOAD

The world of science behind
EXIDE-IRONCLAD BATTERIES

Being interviewed is Curtice C. White, Senior Development Engineer.

"These channels actually cool the battery"

At the Exide Laboratories—**Reporter:** First, Mr. White, tell me what makes a battery hot.



White: Heavy loads—they often raise battery temperature as much as 20 degrees.

Reporter: How do the channels cool it?

White: The heated electrolyte rises to the top through the channels. Plates are cooled by electrolyte coming up from the bottom.

Reporter: Don't all batteries have channels?

White: Unfortunately, no. It is the tubular construction of the Exide-Ironclad positive plate that leaves these channels on both sides.

Reporter: What does this feature mean in battery performance?

White: Longer battery life, for one thing. The battery stays cooler. Has less incidence of hot spots. Plates operate at a more uniform temperature.

Reporter: Obviously this is an important feature of Exide-Ironclad.

White: Yes it is, but it's just one of many engineering details that contribute to its high capacity and long life.

Note to battery users: Whenever you order heavy duty batteries or the equipment that requires them, be sure to specify Exide-Ironclad. For detailed bulletin, write Exide Industrial Division, The Electric Storage Battery Co., Philadelphia 2, Pa.

THE ELECTRIC STORAGE BATTERY COMPANY **Exide®**

THESE KENNAMETAL REPRESENTATIVES HAVE 555 YEARS OF MINING EXPERIENCE

. . . and each is a specialist in real service in the application and utilization of Carbide Mining Tools

37 years

EDWIN H. JOHNSON
Division Manager

15 years

EDWARD J. CARROLL
Assistant Sales Manager

51 years

ROBERT J. McGINNIS
Supervisor, Latrobe, Pa.

26 years

CHARLES P. ADAMS
Vincennes, Ind.

14 years

JACK W. BEGLEY
Bluefield, W. Va.

38 years

MAX J. CAYLOR
Mars, Pa.

21 years

DALE CHRISTOPHER
Morgantown, W. Va.

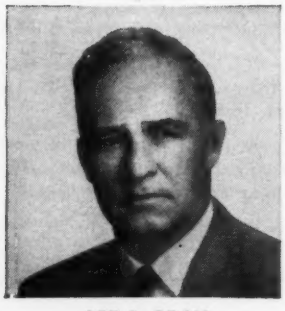
24 years

MIKE K. COOKE
Wilkes-Barre, Pa.

22 years

STEWART EDWARDS
Waynesburg, Pa.

25 years



ABE L. GRAY
Blairsville, Pa.

16 years

BIRCHELL R. HELTON
Barbourville, Ky.

40 years

DARIO S. PARISI
Cadogan, Pa.

21 years

ARNOLD RIGGS
Crooksville, Ohio

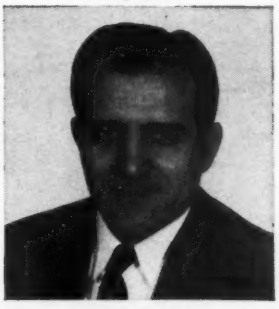
24 years

ORVAL ROBSON
Supervisor, Waynesburg, Pa.

43 years

ROBERT T. SMITH
Glenshaw, Pa.

20 years

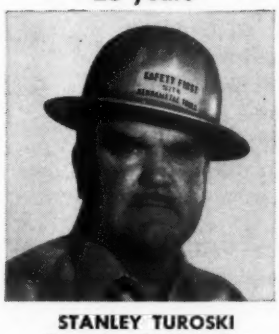


BENEDICT TEANO
Oak Hill, W. Va.

23 years

DOUGLAS L. TUNSBERG
Chattanooga, Tenn.

25 years



STANLEY TUROSKI
Supervisor, Bedford, Pa.

25 years

DICK W. WELCH
Rimersburg, Pa.

21 years

J. VAUGHN WILCOX
Supervisor, Springville, Utah

24 years

JOHN D. WINGARD
Benton, Ill.

Kennametal Representatives offer more than just a product . . . they offer a *service*, too. Each man has served long years in the mines, has a sound, first-hand knowledge of every phase of operation. Each will go underground to appraise any individual problem, and then recommend the proper tool and proper drilling and cutting procedures to take care of the situation.

Each will, upon request, instruct machine operators in how to get the best from the tools, and, if desired, will conduct and supervise tests to evaluate performance in actual operation. Finally, any man will, if asked, instruct mine maintenance men in the proper methods of regrinding and reconditioning Kennametal Tools.

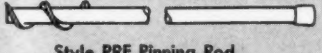
Feel free to call for this help at any time . . . it is always at your service!

C-3029

INDUSTRY AND
KENNAMETAL
. . . Partners in Progress

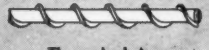
AVAILABLE . . . a complete line of Kennametal Cutter Bits, Drill Bits, Roof Bits, Pinning Rods, Augers and Accessories

Style PR Pinning Rod

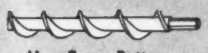


Style PRF Pinning Rod

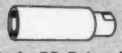
Snap-Button Shank Auger



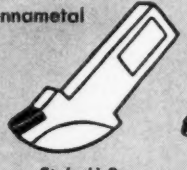
Threaded Auger



Hex Snap-Button Shank Auger

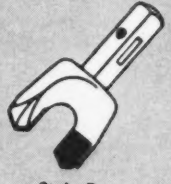


Style BR Drive Socket

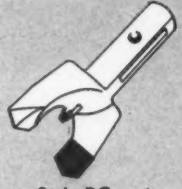


Style U-8

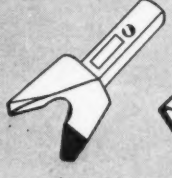
Style U9R



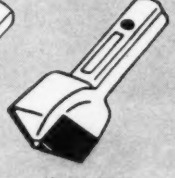
Style D



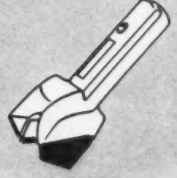
Style DC



Style DL



Style FDH



Style FDL

Style PA

for tough screening jobs . . .

CF&I INDUSTRIAL SCREENS

You can depend upon CF&I Industrial Screens to give long service life with little downtime no matter how tough your screening job. That's because CF&I Screens are made from specially selected steel which is crimped and woven extra tightly to assure high production throughout screen life—even when the screens are subjected to severe abrasion, corrosion or high temperatures.

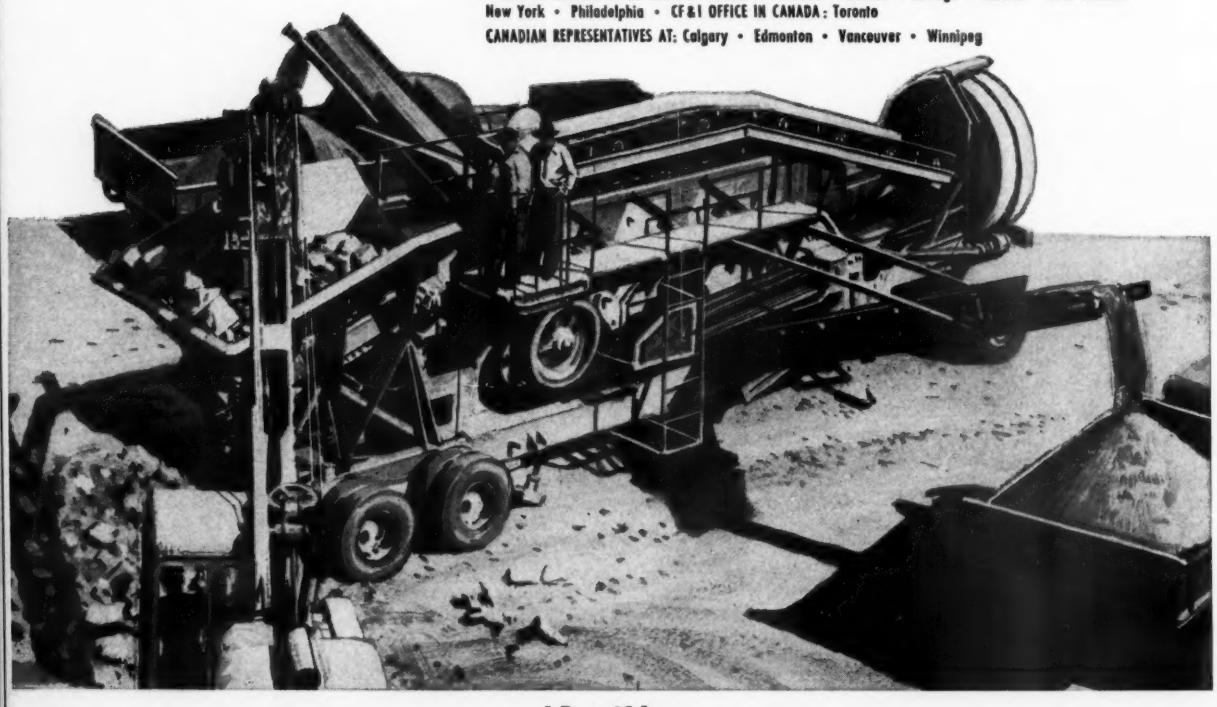
Next time you need an industrial screen, be sure you investigate CF&I Industrial Screens—you'll be glad you did.

CF&I SPACE SCREENS

THE COLORADO FUEL AND IRON CORPORATION

THE COLORADO FUEL AND IRON CORPORATION—Albuquerque • Amarillo • Billings • Boise • Butte • Casper Denver • El Paso • Ft. Worth • Houston • Lincoln (Neb.) • Los Angeles • Oakland • Oklahoma City Phoenix • Portland • Pueblo • Salt Lake City • San Antonio • San Francisco • Seattle • Spokane • Wichita WICKWIRE SPENCER STEEL DIVISION—Atlanta • Boston • Buffalo • Chicago • Detroit • New Orleans New York • Philadelphia • CF&I OFFICE IN CANADA: Toronto

CANADIAN REPRESENTATIVES AT: Calgary • Edmonton • Vancouver • Winnipeg



THE SPLICE OF LIFE

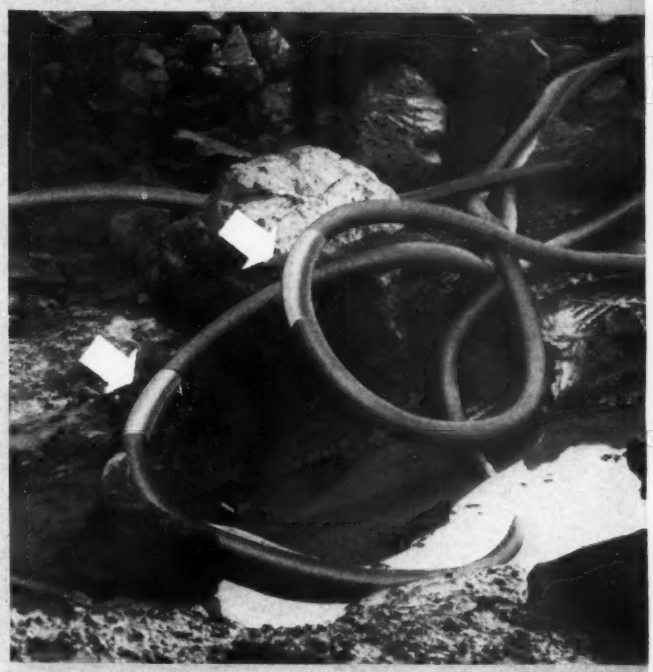
When you splice and reinsulate with Uskorona® and re-jacket with "D.R." splicing compound, you renew the life of the cable. *The entire splice will last as long as the cable.*

These entirely reliable tapes are:

- Extra-tight gripping, plus high in tensile strength.
- Resistant to acid, alkalies and moisture ... ideal for use on mining machine cables.
- Impossible to pinhole, so dangerous leaks can't occur.
- Absolutely waterproof.

Uskorona exceeds A.S.T.M. specifications and can handle a wide range of electrical and general purpose jobs in mines. A complete line of mine tapes is available at any of the 28 "U.S." District Sales Offices, at selected distributors, or write us at Rockefeller Center, New York 20, N. Y. In Canada, Dominion Rubber Co., Ltd.

US RUBBER USKORONA SPLICING TAPE



ABOVE GROUND. When spliced with Uskorona and "D.R." tapes, cables become perfect again. These splices restore the mechanical and dielectric quality of the cable, resist severe abrasion and exposure to moisture.

BELOW GROUND. Being run over by cable cars in coal mine can't hurt Uskorona splices protected by "D.R." splicing compound. They take this punishment many times a day.

US RUBBER

Mechanical Goods Division

United States Rubber

Ohio Brass

FIRST IN MINE HAULAGE

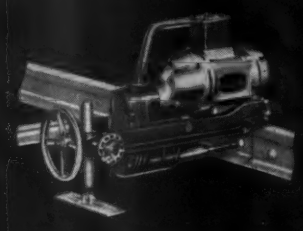
locomotive equipment, rail bonds, line materials, automatic couplers, safety, and control equipment.

If your problem concerns accessory equipment for mine haulage, you'll find a solution at Ohio Brass -- perhaps even among the O-B products and publications shown on these pages.

For over half a century, mine operators in this country and throughout the western hemisphere have come *first* to O-B with their coupler, collector, bond, line material, switch, and electrical equipment problems -- for every haulage need, in fact, from simple hangers to the most comprehensive blueprints for complete haulage systems.

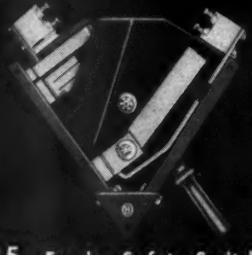
To get our monthly "how-to-do-it" bulletins, or more information on any product, fill out and mail the coupon below.

1. Cable Connectors



5. Rail Drills for Wedge Bonding

10. Porcelain Insulators



15. Feeder Safety Switches (Cover Removed)

19. Rail Clamps

OHIO BRASS COMPANY, MANSFIELD, OHIO

4805-M

Name .....

Company .....

Position .....

Address .....

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

16 17 18 19 20 21 22 Other.....

☐ *A Storehouse of Ideas*—O-B Mining and Industrial Catalog No. 27 is loaded with suggestions for more efficient haulage. Check the box to get your copy.

☐ *A Library of Information*—O-B Haulage Ways brings 8,000 mining men "how-to-do-it" articles and new product information every month. Just check the box to add your name to the list.

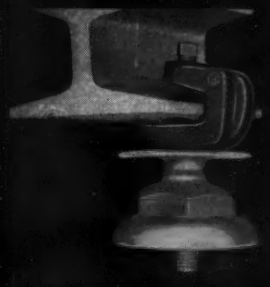
☐ *Aluminum Feeder Cable*—Supplement No. 1 to the O-B No. 27 Catalog lists O-B fittings for aluminum cable and describes correct installation procedures. Check box for your copy.

2. Trolley Frogs, Crossovers

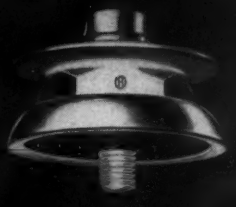
3. Expansion Bolts

4. Automatic Couplers

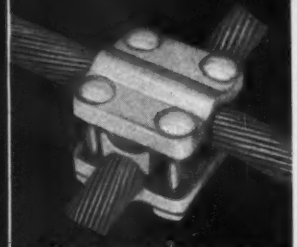
6. Trolley Wire Clamps



7. Hanger Adapters

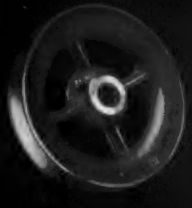


8. Insulated Hangers



9. Branch Connectors

11. Trolley Wire Conditioning Equipment



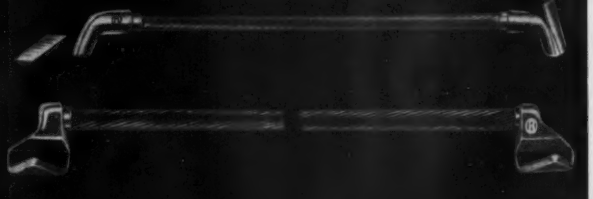
12. Wheel Collectors

13. Feeder and Trolley Splicers

14. Quick Break Switche

16. Shoe Collectors

17. Fused Taps



18. Rail Bonds

20. Section Insulator Switches

21. Combination Feeder Trolley Clamps

22. Bond Welding Equipment

HD-21 crawler tractor, 204 net engine hp
315 scraper, 20 yd heaped, 15 struck

YOU CAN STRIP OVERBURDEN AND RECLAIM LAND PROFITABLY

with this crawler tractor-scraper team

There is a marked trend toward reclaiming worked-out pits—and a parallel trend toward the use of Allis-Chalmers crawler tractors and scrapers. Both are examples of wise management.

Land Reclamation—already a law in many states—eliminates to a large extent the scarred and worthless landscapes left by abandoned pits and piles of overburden. Properly reclaimed land usually returns far more than the cost of reclamation in higher resale value. Even where pits can be only partially filled, the land may be seeded profitably for pasture.

Allis-Chalmers HD-21 Crawler Tractor and 315 Scraper are ideal for this type of operation. This team is mobile and flexible enough to strip overburden and spread it immediately in a worked-out area of the pit. This eliminates the need of re-handling overburden and of calling in specialized equipment.

Curved and offset cutting edge on the scraper, plus torque converter drive on the tractor, are just two of many features that put this Allis-Chalmers team in a class by itself for this type of work. Let your Allis Chalmers construction machinery dealer give you the details. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS *Engineering in Action*

Best For Main or Auxiliary Air Supply!

Above: 9′ Joy Axivane Mine Fan teams with an 8′ Joy Fan to provide main ventilation system for Climax Molybdenum Company mine.

Left: 10 H.P. V-belt drive Joy Axivane Fan moves 50,000 feet of air each minute. Ideal for auxiliary or small-mine ventilating duty. Photograph courtesy U.S. Bureau of Mines.

JOY AXIVANE MINE FANS

MAIN AIR SUPPLY Low operating speed, wide operating range, simultaneous . . . and easy . . . blade adjustment, and ready bearing accessibility assure you efficient, dependable ventilation for your mine. The big 9′ Joy Axivane Fan illustrated at top right is in operation at Climax Molybdenum Company's mine in Climax, Colorado. This V-belt driven fan produces air volumes from 81,000 CFM to 770,000 CFM, and above, with pressures up to 15″ w.g. It teams with an 8′ Joy Fan to furnish the main air supply for the Climax mine.

AUXILIARY AIR SUPPLY The 10 H.P. V-belt drive Joy Axivane Fan, illustrated at top left, moves 50,000 feet of air each minute with total pressure of .75 inches. Fitted with reversible motor, this efficient air-moving machine is ready to exhaust stale air or draw in fresh air for the working crews. Remote-controlled adjustable blades allow you precise control of air volume and pressure. It is designed for auxiliary ventilation service in a large mine or for primary ventilation in a small mine.

The vaneaxial design of Joy Mine Fans conforms to the latest formulae of aerodynamics . . . to give you increased efficiency and greater power savings. Joy Axivane Mine Fans are available in sizes up to 12′ in diameter, with air volumes up to 1,120,000 CFM. For full details write to ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Write for FREE Bulletin 56-3

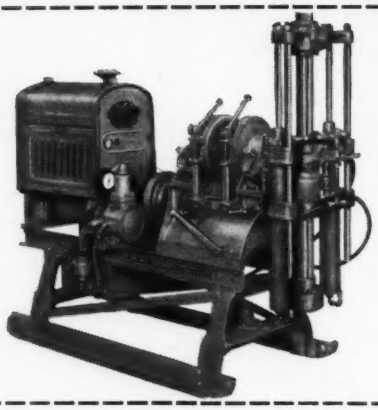
Consult a Joy Engineer

WSW CL5967-56

JOY

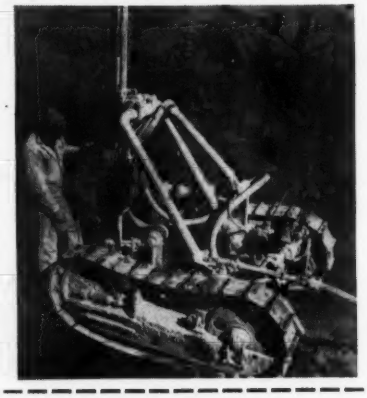
WORLD'S LARGEST MANUFACTURER OF VANEAXIAL-TYPE FANS

EXPLORATORY



Versatile Skid-Mounted CP Core Drills—are also available without skids for truck or jeep mounting. Air, electric, gasoline and diesel drives. Capacities to 2250 feet with E—EX fittings.

OPEN PIT



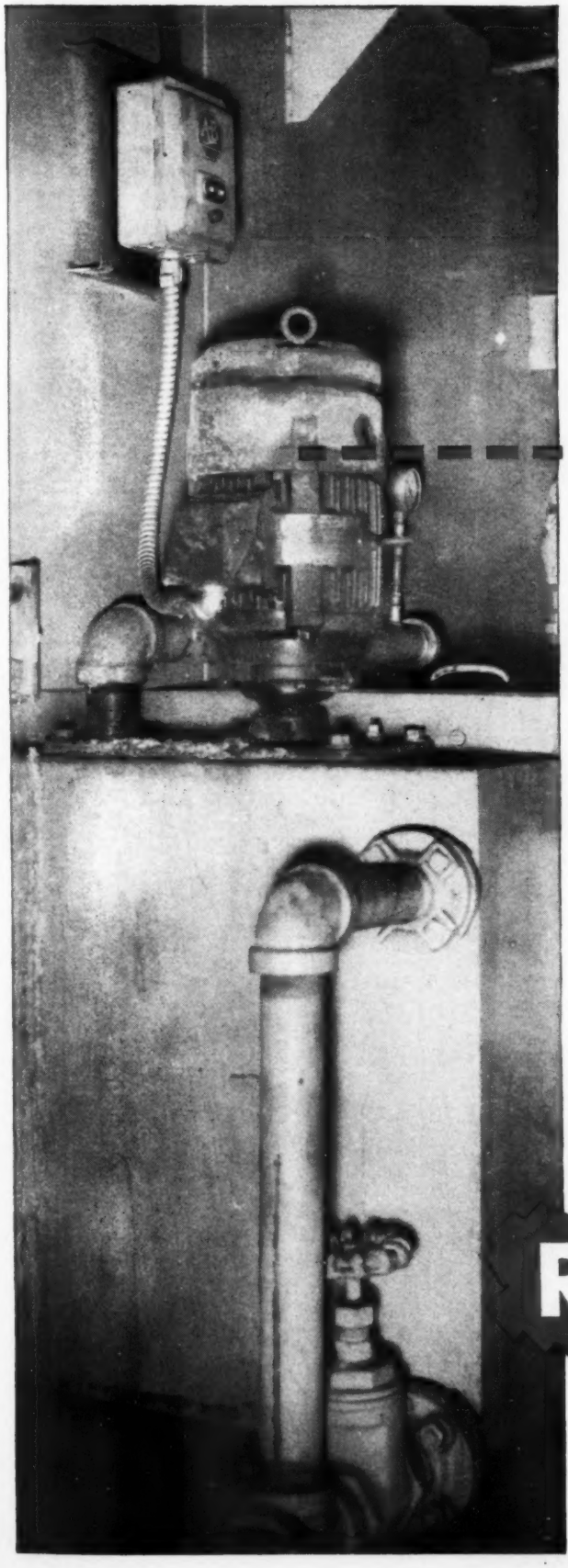
Self-Propelled G-800 Tracdril — mounts either a hard-hitting 4″ or 4½″ deep hole drill in standard, or standard-neutral-reverse rotation types.
OTHER OPEN PIT EQUIPMENT: Hydraulic Boom Arms (can be mounted on your tractor); CP Rotauger (can be mounted on G-800 Tracdril or tractor for rotary drilling in softer formations).

UNDERGROUND

5 Airleg Models available in *Attachable* types for conversion of standard sinkers to airleg operation and in *Integral* types for production drilling. In feed lengths of 36″ and 48″. OTHER UNDERGROUND EQUIPMENT: CP Rotaugers; Stopers; Drifters, Hand Held Sinkers.

Chicago Pneumatic *8 East 44th Street, New York 17, N. Y.*

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES



RELIANCE solves motor corrosion problem

This Reliance Corrosion-Proof Motor is operating a pump which circulates cleaning solution through a tank containing metal parts. The motor is subjected to corrosive vapors and liquids each time a basket of parts is removed. BUT THIS MOTOR WILL NOT CORRODE.

The solid cast-iron housing, including the fan cover, will withstand corrosive service indefinitely. Wiring identification is preserved on a stainless steel name plate. A threaded outlet is provided on the water tight conduit box, and motor leads are molded into a neoprene gasket that completely seals off the windings from the conduit box. A neoprene or non-ferrous shaft slinger seals the only other frame opening.

These and many other features give you a motor with a built-in corrosion protection. Why not install this superior design now and save many replacement dollars in the years ahead.

Write for bulletin B-2406 for complete design details.

B-1854

R

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 96A, CLEVELAND 17, OHIO

CANADIAN DIVISION: WELLAND, ONTARIO

Sales Offices and Distributors in Principal Cities

perfect balance of hardness and toughness for the long economical grind

The alloying, forging and heat treating techniques used by Sheffield assure unvarying quality to the very core of every Moly-Cop ball. This is why they are known for long service and high production economies — why they have become the STANDARD OF COMPARISON AROUND THE WORLD.

SHEFFIELD

ARMCO®

MOLY-COP

TRADE MARK

COPPER-MOLYBDENUM-ALLOY

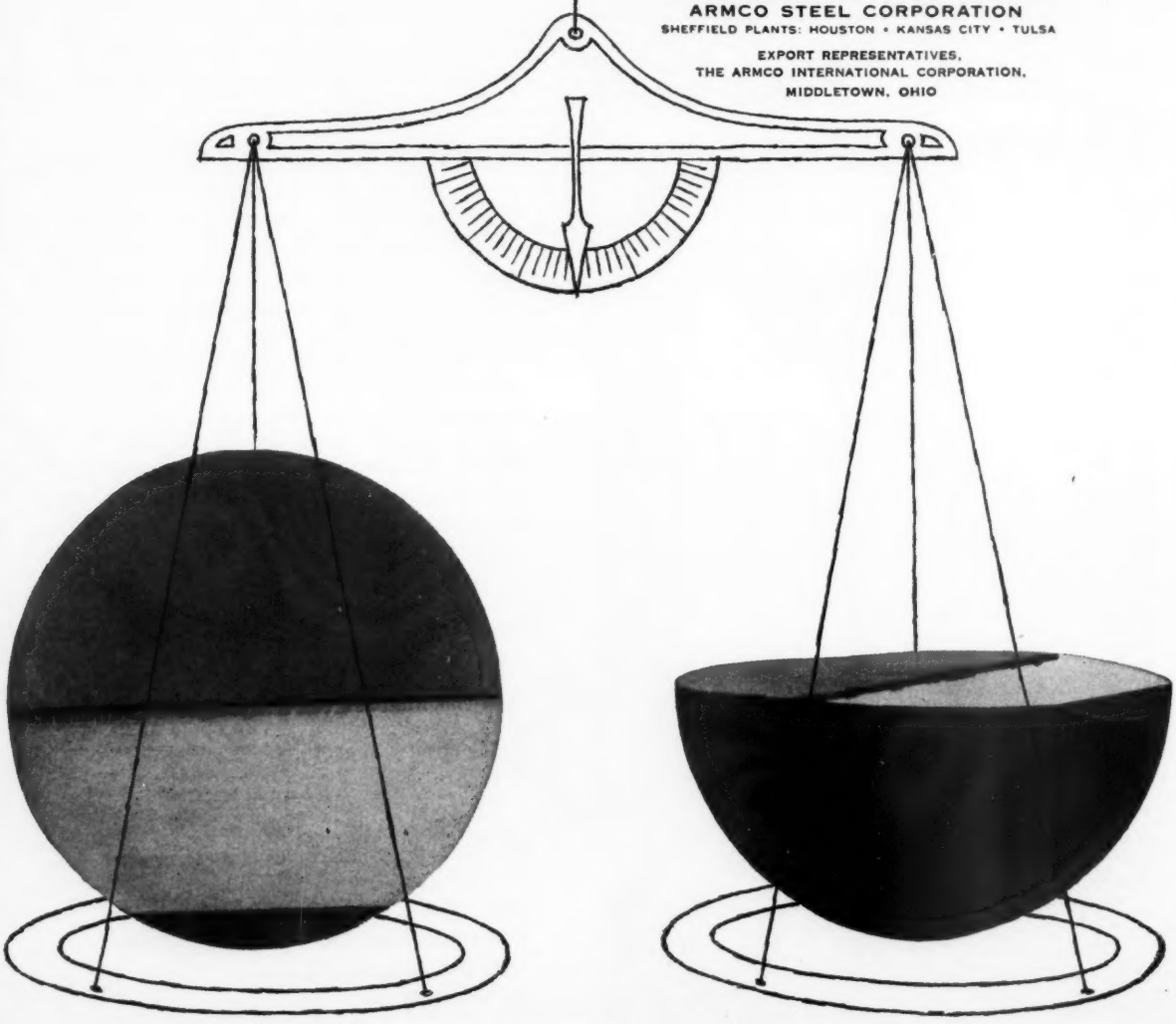
Grinding Balls

SHEFFIELD DIVISION

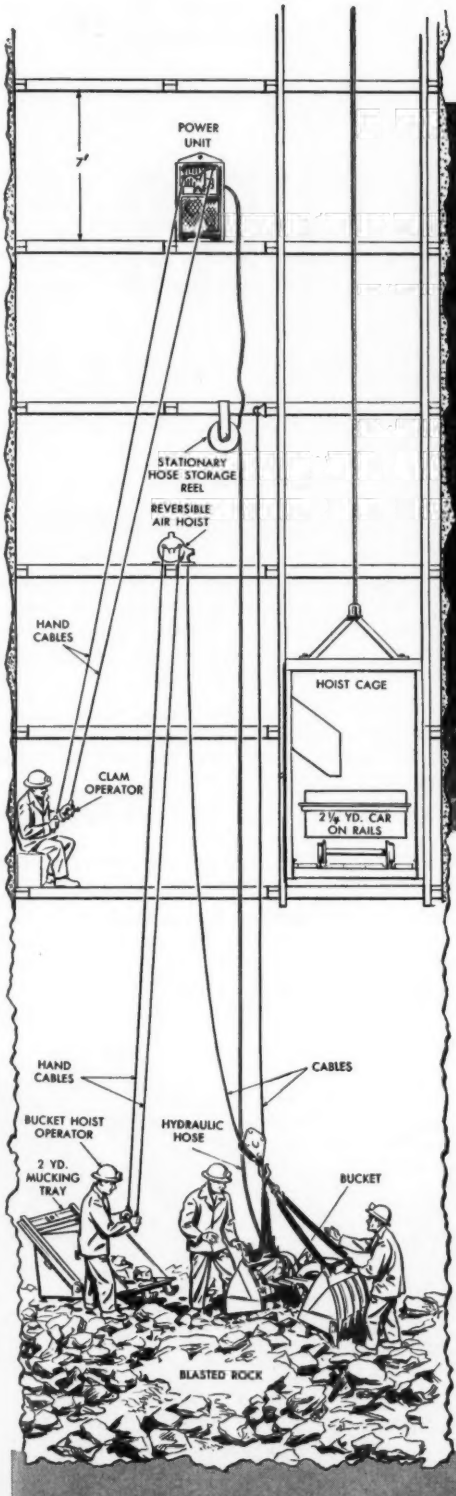
ARMCO STEEL CORPORATION

SHEFFIELD PLANTS: HOUSTON • KANSAS CITY • TULSA

EXPORT REPRESENTATIVES,
THE ARMCO INTERNATIONAL CORPORATION,
MIDDLETOWN, OHIO



SINK SHAFTS FASTER
WITH BUCYRUS-ERIE
HYDROMUCKER



Here is a hydraulic shaft mucking device that increased production 35 per cent at one mine — and freed 30 per cent of the manpower for other work! Let's look at the reasons why:

1. The hydraulically operated clamshell bucket digs into the muck pile — does not pull away during closing as do rope-reeved clamshells.
2. Clamshell operator can be stationed on a shaft set above the muck pile — out of the way, yet in excellent position to see the operations.
3. Muck can be loaded by the clamshell into a tray or other container which is placed near the digging. When full, this unit is dumped into a skip or car and hoisted to the surface.
4. Very little preparation is necessary to start the mucking cycle. Only the container and hydraulic bucket are hoisted out of the way during blasting, so only minutes are required to connect the hydraulic line and begin mucking.

Sink your shafts the faster, easier, mechanized way with Bucyrus-Erie Hydromucker — ⅜- or ½-yd. capacity. Write for details or see your Bucyrus-Erie distributor. 211H57

BUCYRUS ERIE

SOUTH MILWAUKEE, WISCONSIN

How to get better coal hauler engine performance—

use **STANDARD DIESEL FUELS**

STANDARD Diesel Fuels—now with STA-CLEAN*—deliver the *big* benefits that help you get (1) the power your coal hauler engines are rated to deliver, (2) the performance economy you must have, (3) the low maintenance costs that mean profitable operations.

STA-CLEAN is a STANDARD Diesel Fuel exclusive. This additive prevents fuel-injector sticking, insures clean burning of the fuel, prevents rusting of tanks, fuel lines, and injector parts.

Clean fuel. Standard exercises special care in handling diesel fuel to make sure it's delivered to you as clean as it was when it left the refinery. Contamination is eliminated. There's no foreign matter in the fuel to cause engine failure or maintenance problems.

Balanced distillation of STANDARD Diesel Fuels means good, as well as economical, performance; and with cleaner engine operation, you may be able to extend overhaul periods for your coal haulers.

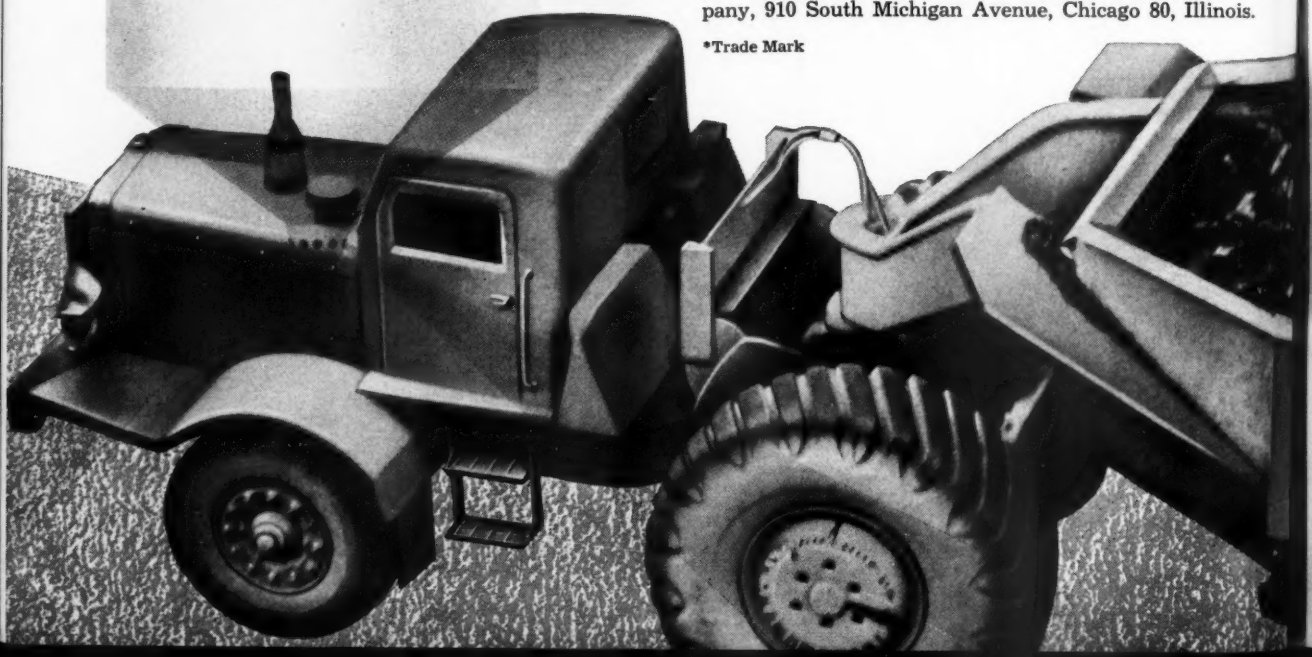
Low pour point. STANDARD Diesel Fuels delivered to operators in cold climates have a pour point of −20° F. or lower . . . plenty of margin here to insure uninterrupted operation at low temperatures.

Get the facts about STANDARD Diesel Fuels from your Standard Oil industrial lubrication specialist. There's one of these specialists near you in any of the 15 Midwest and Rocky Mountain states. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

*Trade Mark

STANDARD OIL COMPANY
(Indiana)

STANDARD



NEW LONG Model 88-C PIGLOADER

with the lowest operating height of any high-capacity loading machine

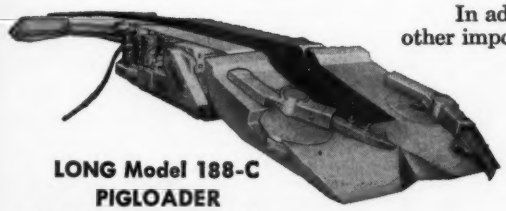
The only loader designed specifically for continuous loading with the Piggyback Conveyor System

Representing the first major innovation in loading machine design in many years, the LONG Pigloader* offers low operating height, straightforward design simplicity, minimum maintenance, high-capacity operation, full independent crawler control, unequalled stability, and unusual digging and tramming power—all vital to handling the high-concentrated tonnages of the Piggyback* Conveyor System of mining.

In this design, a single 40 HP electric motor drives all machine operations. All functions are controlled hydraulically from a single bank of finger-tip control valves. Maximum digging and tramming power is provided as the full 40 HP can be utilized for each operation. Long wheel base and wide tracks give exceptional stability and positive operation even in soft bottom. With the Pigloader's tramming and digging ability, it is able to go to the back of the cut with each pass at the face. Rated capacity is 4 to 6 tons per minute and tramming speed is 95 feet per minute.

In addition to its superior operating features, the Pigloader offers other important advantages. For example—it has fewer, heavier parts, and its simplified design greatly facilitates maintenance.

*Pigloader and Piggyback are trade marks (Reg. U.S. Pat. Off.) of The LONG Company

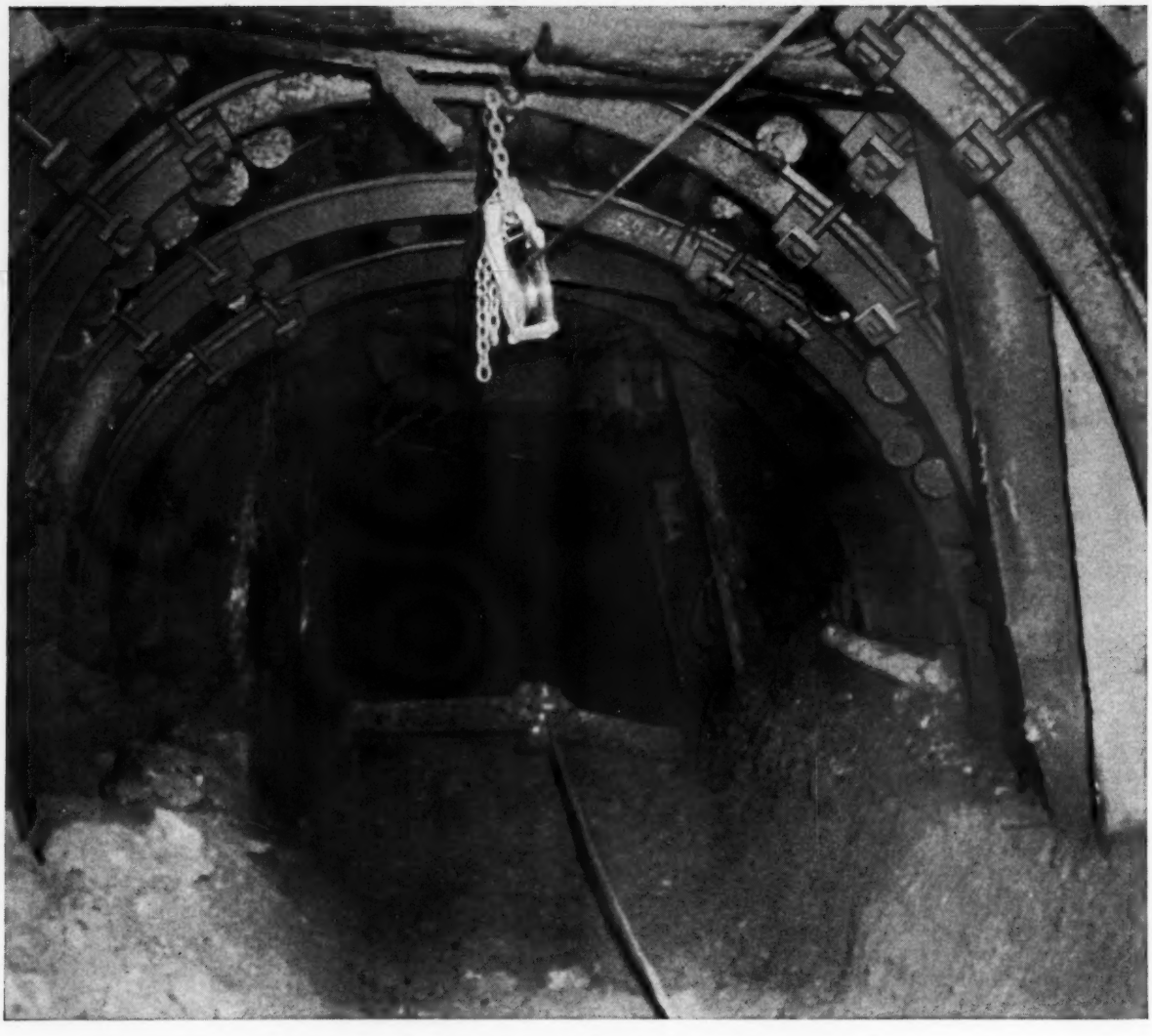


LONG Model 188-C PIGLOADER For Shuttle Car Loading

The Model 188-C is identical to the 88-C, except it is equipped with a swing boom for loading into shuttle cars.

Write for Bulletin No. 4010—or ask for a demonstration.

The LONG Company
Oak Hill, W. Va.



See how the Yieldable Arch "*gives*" under excessive pressures

That is just what Bethlehem's Yieldable Arch was designed to do. Each arch set is made up of segmental sections which nest together at points of overlap, as is clearly shown in illustration. These overlapped joints are held by U-bolt clamps which are drawn up tight enough to create the right amount of friction. Under excessive load, however, the joint will yield, which it has already started to do in the installation shown above.

Where underground conditions are difficult no rigid roof support, however strong, can indefinitely withstand the dynamic pressures caused by the weight and subsidence of the overburden. What's needed is a support scientifically designed to yield *gradually*, in order to keep the drift open while an area is being worked out.

Thus you can see that it's not the strength but the "give" of the Yieldable Arch that holds a tunnel or drift open. Because the arch sets yield before the steel deforms, they are recoverable for use elsewhere. In mines where the Yieldable Arch is at work, it is paying for itself amazingly quickly, sometimes in a matter of months.

The Yieldable Arch is easy to install without special equipment or skills. One of our engineers will be glad to look over your workings and see what the Yieldable Arch has to offer you. You can reach him by calling or dropping a line to the nearest Bethlehem district sales office.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

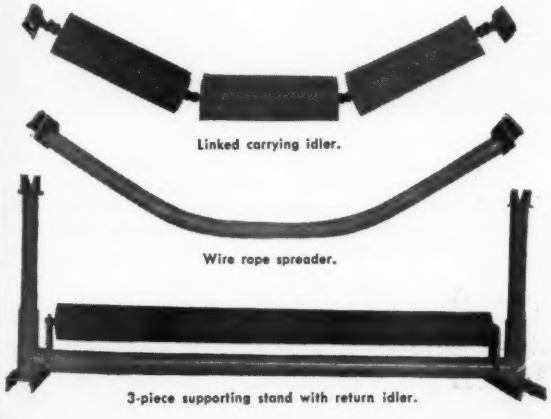
Wet iron ore moves smoothly and quickly in this mine where two Goodman Rope Belts have been installed in sub-levels.

The Goodman *Rope Belt** Conveyor

for metal mine haulage . . . *COSTS LESS TO BUY . . . LESS TO INSTALL . . . HAS HIGHER CARRYING CAPACITY . . . NEGLIGIBLE SPILLAGE*

It's easy to see why initial cost is low. With parallel wire ropes taking place of the usual rigid framing, the saving in the cost of intermediate sections is obvious. Accurate mine records show savings as great as 50%.

The same thing applies to installation and extension. There are no heavy structural units. Parts are few, simple, easy to handle. This is an important advantage where space is limited. Records show savings of many hours in installation and extension time.



Linked carrying idler.

Wire rope spreader.

3-piece supporting stand with return idler.

No tools are needed to add these parts to conveyor line. There is no framing that requires positioning for hooking or bolting together.

Carrying capacity of the Goodman Rope Belt is unsurpassed. The combined "give" of the tensioned, wire ropes and the linked idler assemblies cups the belt to the load, provides low impact shock at loading points and smooth travel along the line. This means less wear and tear on belt and idlers. And it also means that spillage, with attendant clean-up time, is practically eliminated.

Very important, too, is the adaptability of the Rope Belt to uneven bottom without the need of costly cribbing or supports. And the return belt is fully visible, easily accessible.

The Goodman Rope Belt is practical anywhere in a metal mine for any type of service. It saves time and money. It's the most useful conveyor you can buy.

Ask for full details. There's no obligation.

*Trade Mark

GOODMAN

MANUFACTURING COMPANY

Halsted Street and 48th Place, Chicago 9, Illinois

CUTTING MACHINES • CONVEYORS • LOADERS
SHUTTLE CARS • LOCOMOTIVES • CONTINUOUS MINERS

Use Genuine Goodman Replacement Parts

NORDBERG MACHINERY
. . . used by leading TACONITE producers

To provide adequate iron ore reserves for today's increased steel production, the large-scale beneficiation of Taconite ore has become imperative.

Long used in the economical production of Taconite concentrates in the Arctic region of Norway, Nordberg Machinery is now serving the huge Taconite operations in northern Minnesota . . . where a new era in U.S. iron ore production is now underway.

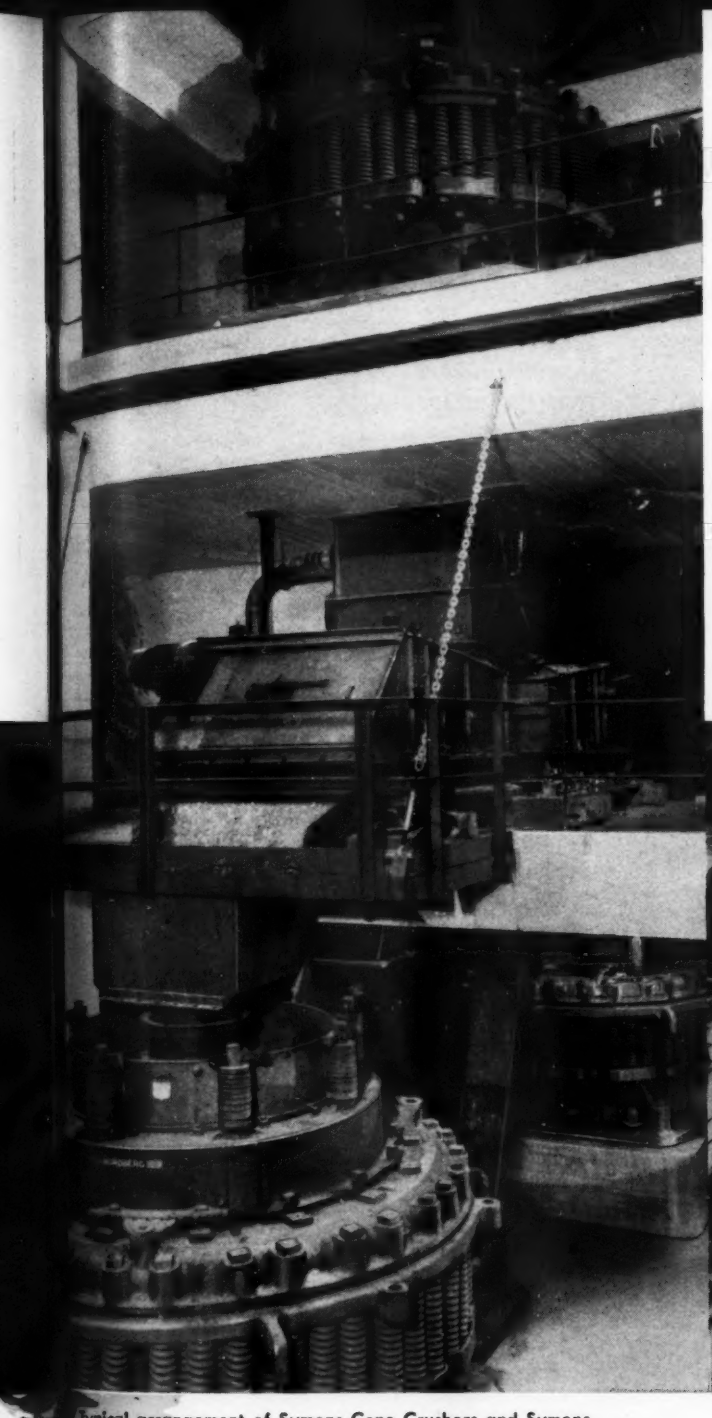
The selection of Nordberg Machinery for the processing of the extremely hard Taconite ore again follows the trend of the mining fraternity to rely on this heavy duty machinery for its proven ability to reduce ores and minerals at low per ton cost.

Nordberg Machinery now in use by leading Taconite producers includes Symons® Primary Gyratory Crushers, Symons Cone Crushers, Nordberg Rod and Ball Mills, and Symons Rod Deck Screens.

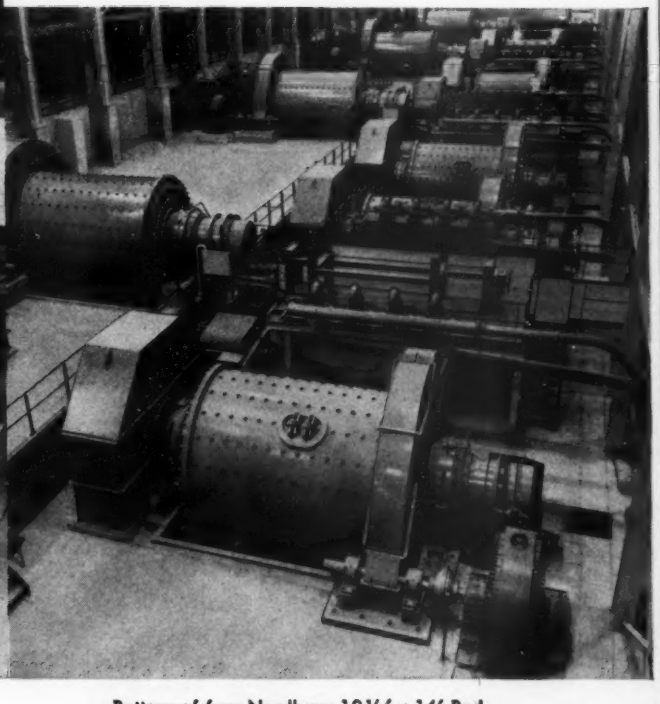
While *your* crushing and processing problems may not involve Taconite, you may be sure that Nordberg machinery is the logical choice for practically any other ore and mineral processing operation where big tonnages at low cost are required.

This Symons Primary Gyratory Crusher has a feed opening of 54" and capacity of 2000 or more tons per hour of hard, abrasive Taconite ore. Symons Gyratories are built in sizes up to 72" feed openings, with capacities of over 3500 tons per hour.

NORDBERG MFG. CO., MILWAUKEE,



Typical arrangement of Symons Cone Crushers and Symons Vibrating Rod Deck Screens installed for secondary and tertiary crushing, and screening of Taconite ore. Cone Crushers of this type are built in sizes up to 7′ diameter, with capacities to over 900 tons per hour.



Battery of four Nordberg 10½′ x 16′ Rod Mills and eight Nordberg 10½′ x 14′ Ball Mills installed in a large Taconite concentrating plant. Other Nordberg Grinding Mills are built in sizes from 6′ to 13′ diameter and up to 50′ in length in Rod, Ball, Pebble, Tube and Compartment types.

SYMONS . . . A REGISTERED NORDBERG TRADEMARK KNOWN THROUGHOUT THE WORLD

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M257

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MACHINERY FOR PROCESSING ORES and INDUSTRIAL MINERALS

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Dig Faster...

Dump Cleaner...

Last Longer

INCREASE YARDAGE

Any way you look at it – from any angle – it's the taper that makes *ESCO* dragline buckets dig faster, dump cleaner, and last longer.

DIG FASTER. Bucket sides flare outward from the lip to increase loading speed. Materials are not compressed into the opening but allowed to expand and flow up and back along the tapered sizes filling the bucket completely without voids in the rear. Bucket fills in shorter drag distance, less line pull required.

DUMP CLEANER. Taper from front to rear and outward flare from lip to arch allows load to drop quickly and easily from the bucket. Load dumps clear of high tubular arch.

LAST LONGER. Tapered design reduces loading and dumping friction to an absolute minimum. Bucket lasts longer. All welded construction and the maximum use of alloy steel castings makes a high strength-to-weight ratio resulting in "lower cost per yard operation".

Bring your bucket problems to ESCO, your bucket specialists. ESCO will "job-tailor" a bucket to your operation. Ask your nearest ESCO dealer for complete details, or write direct.

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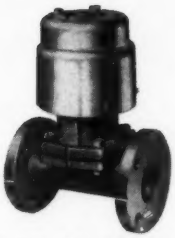
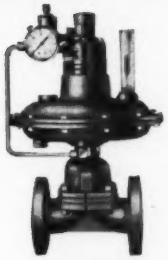


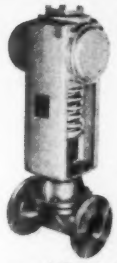
Bendix-Westinghouse Rotochamber



Conoflow

Fisher Governor

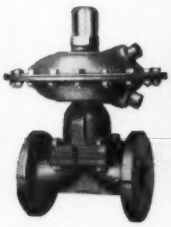
Foxboro Reversible Stabiflo



General Controls Hydramotor

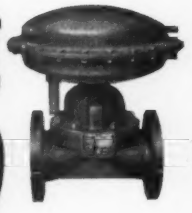
GRINNELL-SAUNDERS DIAPHRAGM VALVES with famous name POWER OPERATORS

Grinnell Air Motor, Spring Loaded



Grinnell Air Motor, Double-Acting

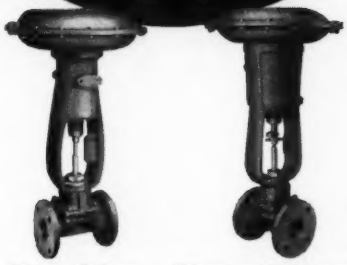
Grinnell Piston



Hammel-Dahl Close-Coupled

Hammel-Dahl Preloaded

Kieley & Mueller



Mason-Neilan Minneapolis-Honeywell

Philadelphia Gear Limitorque

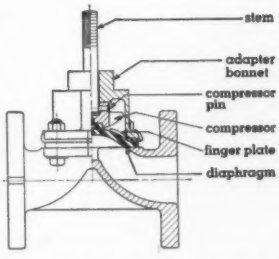
Taylor Motosteel

GRINNELL-SAUNDERS Diaphragm Valves are easily equipped for power operation — by combining any of numerous power operators, a sliding stem bonnet assembly, and a valve body. The sliding stem bonnet can be modified to accommodate any make of power operator, pneumatic or electric.

Grinnell-Saunders Diaphragm Valves are unsurpassed for handling materials as diversified as corrosive fluids, gases, beverages, foods . . . in lines where corrosion, abrasion, contamination, clogging, leakage and maintenance are costly factors.

The operating principal of the Grinnell-Saunders Diaphragm Valve is simple. The resilient, flexible diaphragm is lifted high when the compressor is raised and pressed tight against the body weir when the compressor is lowered.

Grinnell valves are available with body, lining, and diaphragm materials to meet different service conditions. For further information, write Grinnell Company, Inc., 229 West Exchange St., Providence, R. I.



This sliding stem bonnet is specially designed for power operation. The power operator is attached to the adapter bonnet and to the threaded end of its free-sliding stem. Thus, the operating force is applied *directly*. The stem, in turn, is directly connected to the compressor which opens and closes the valve when power is applied. This sliding stem bonnet is interchangeable with other bonnet designs.

GRINNELL

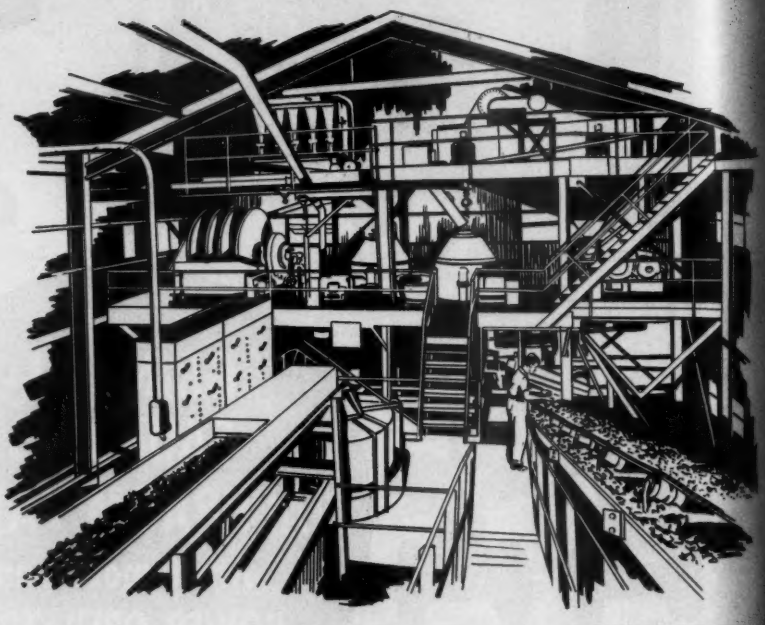
WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • ● Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

This modern plant processes over 100 tons per hour of ⅜" x 0" raw coal feed. Specifications call for clean coal of not more than 5½% ash. Surface moisture is reduced to under 7½% without heat drying.

Complete Fine Coal Washing and Thermal Drying Plant built by H & P to complement existing coarse coal preparation plant. ⅜" x 0" raw coal is fed at the rate of 140 tons per hour. The clean coal averages 4.75% ash and has a surface moisture of 3%. Plant bleed under normal operating conditions has been 50 GPM at less than ½% solids from the refuse circuit.



The one new Fine Coal Washing Method—
The HEYL & PATTERSON Circuit

A scientifically designed Fine Coal Washing and Water Clarification Plant using the "H & P Circuit" relies on the proven combination of H & P Cyclones, Reineveld Centrifuges, and the new Fluid Bed Dryer for superior performance and low-cost operation.

When you talk to an H & P sales engineer about your fine coal recovery problems, he is backed by the experience of our research department which developed the H & P Self-balancing Circuit after years of painstaking field and laboratory tests.

Since 1891, Heyl & Patterson has designed and built many coal preparation plants. We have adhered to the firmly established basic idea that the exacting requirements of economical coal preparation demand careful engineering analysis and development of flowsheets. These are tailor-made for your specific requirements, to permit maximum recovery and to comply with stream pollution legislation. *Heyl & Patterson has given the coal industry the correct facilities for preparing coal for specific markets, assuring high standards of accuracy and uniformity for its customers.*

The newest development in this challenging field is the application of the H & P Circuit to Fine Coal Washing and Water Clarification Plants. Many of these plants are now in service and their daily operating records confirm these advantages:

- Lower initial investment
- Lower operating and maintenance cost
- Full 100% recovery of all solids reporting from the clean coal discharge of the washing equipment
- Closed water circuit operation where desired

You, too, can enjoy these and other advantages if the layout and design of your Preparation Plant are the result of proper design and equipment application by H & P specialists.

Eliminating all guesswork is the surest way to customer satisfaction. Let us prove our point.

Send for informative brochure on Fine Coal Jig, Reineveld Fine Coal Centrifuge, H & P Cyclones or general Coal Preparation Plant Bulletin.

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BRADFORD COAL BREAKERS
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THERMAL DRYERS
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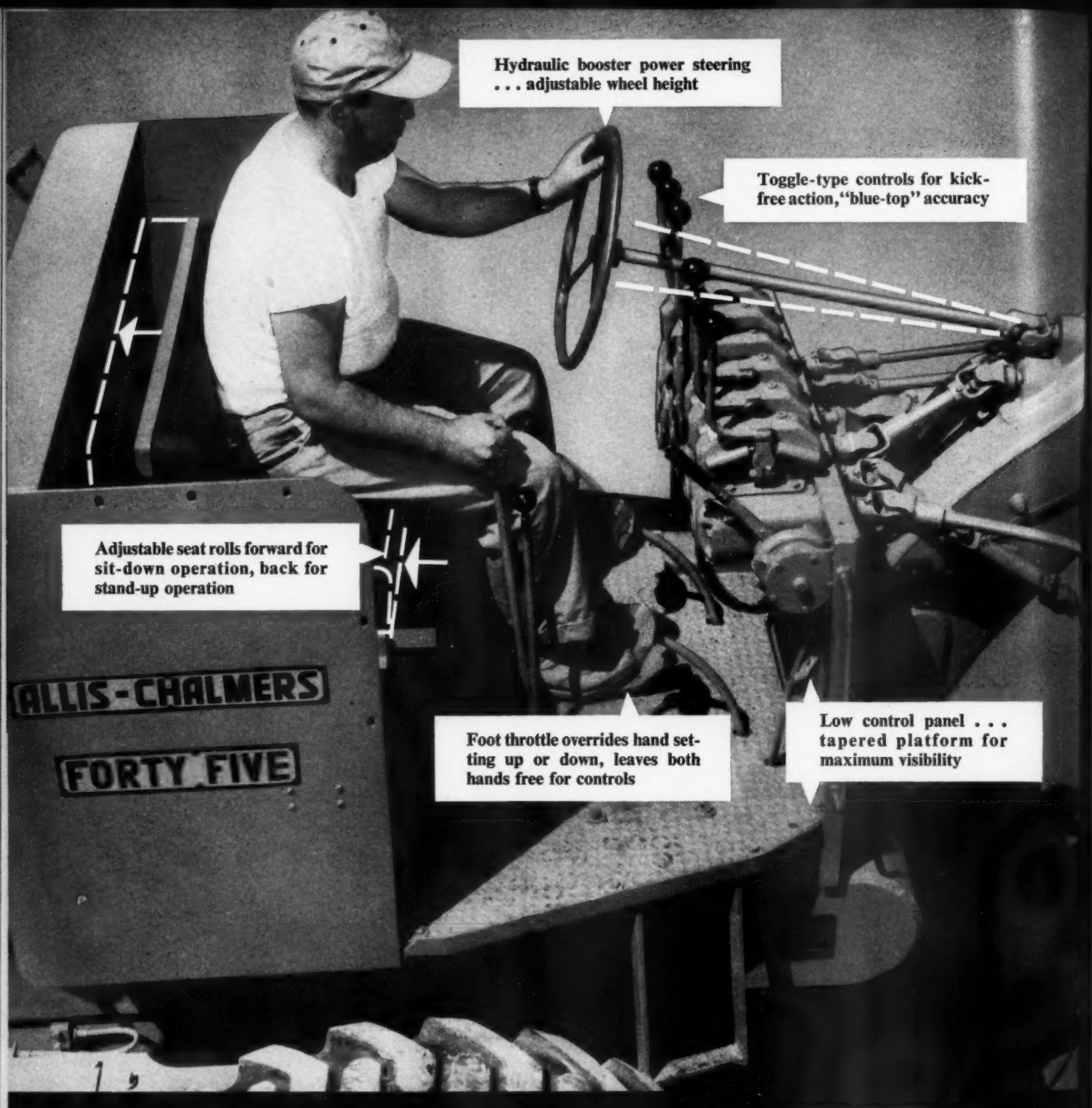
...this is the point ... *where profits begin*

All the more when used in a Bowdil Chain

on a Bowdil Bar

The Bowdil Company

CANTON, OHIO


Hydraulic booster power steering . . . adjustable wheel height
Toggle-type controls for kick-free action, "blue-top" accuracy
Adjustable seat rolls forward for sit-down operation, back for stand-up operation
ALLIS-CHALMERS
FORTY FIVE
Foot throttle overrides hand setting up or down, leaves both hands free for controls
Low control panel . . . tapered platform for maximum visibility

FIVE WAYS YOU CAN BOOST GRADER PRODUCTION

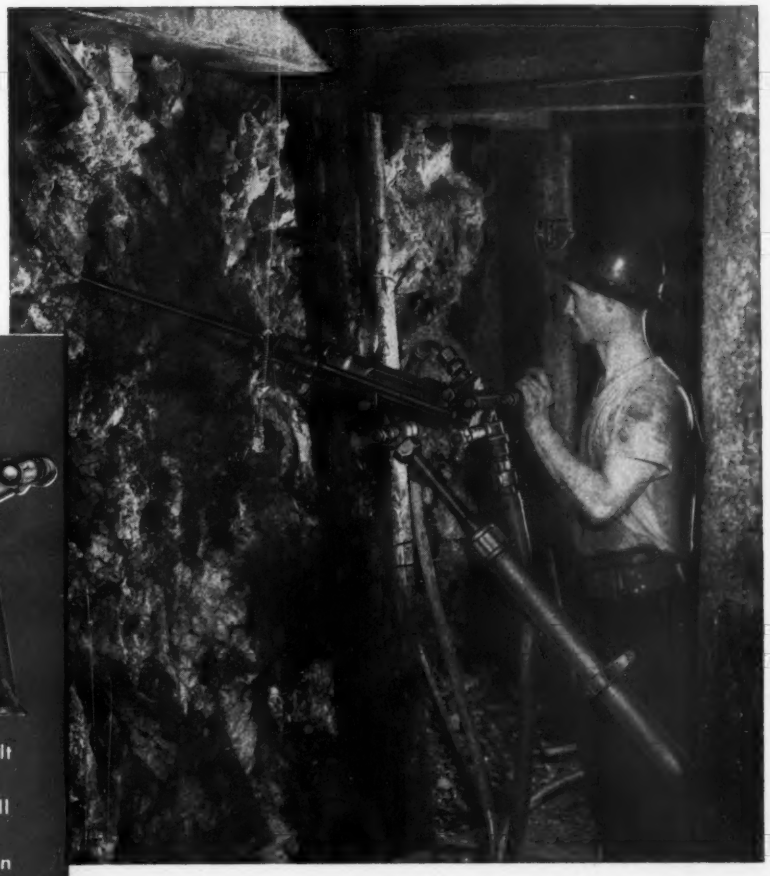
. . . through operator comfort and control!

Features like these make satisfied operators . . . mean more production for you. They're yours in an Allis-Chalmers FORTY FIVE—120 brake hp, 23,800 lb. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS *Engineering in Action*

Here's why the JR-38B
UNIVERSAL JACKDRILL

gives you MAXIMUM FOOTAGE PER SHIFT at LOWEST OVERALL COST



FEATURES

- Roll-Type Feed-Leg Valve built into handle
- Five-Position Throttle controls all functions
- Built-in Air Connection between drill and leg
- Adjustable Tension on hinge joint
- Adjustable Balance for easy handling
- Enclosed Steel Centralizer
- Constant Chuck Blowing
- One-Piece Chuck with renewable bushing
- Extra-Rigid Fronthead Construction
- Lighter Weight Telescopic Leg

Set-up time can be converted to drilling time with the Ingersoll-Rand JR-38B Jackdrill – the easiest-handling one-man universal drilling unit ever developed. Designed to take full advantage of the inherent economies of 1⅜" Carset Jackbits, it saves drilling time, too, and reduces air requirements as well. The JR-38B is rugged – it stays on the job. These savings add up to maximum footage per shift and a new low in drilling costs.

The features at the left give some of the reasons for this outstanding Jackdrill performance. For the complete story, see your I-R man or send for a copy of Bulletin 4144A.

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Ingersoll-Rand

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DRIFTERS • JACKDRILLS • JACKHAMERS • CRAWL-IR DRILLS • CARSET BITS • AIR TOOLS • COMPRESSORS

MINING MACHINE AND LOA
SCRAPER AND DOZER ROPE-
SLUSHER ROPE-WINCH LIN
INCLINE
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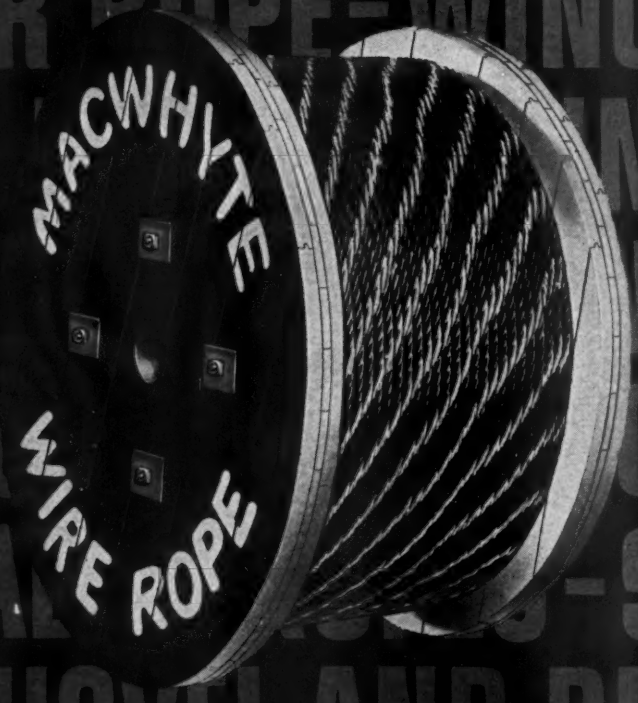
SHOVEL
E RO
MINE HO
CRAPE
AND LOA
-SLUSH
STRIP SHOVEL AND DRAGL
MINE HOIST
WINCH LINES
AND LOADER
INCLINE ROPE
DOZER ROPE



WHYTE STRAND

wire ropes are made to meet the needs of today's high output machines. There is a WHYTE STRAND wire rope in the correct size and construction for each use on every machine. These Macwhyte Ropes are PREformed for maximum flexibility, internally lubricated for super service and stocked for immediate delivery.

Don't guess at the correct rope for your machine, get a Macwhyte recommendation. Catalog G-16 available on request.

MACWHYTE COMPANY
2906 Fourteenth Avenue, Kenosha, Wisconsin
Manufacturers of Internally Lubricated PREformed Wire Rope, Braided Wire Rope Slings, Aircraft Cables and Assemblies, Monel Metal, Stainless Steel Wire Rope, and Wire Rope Assemblies. Special catalogs available.

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free-machining

MAX-EL 3½ ALLOY STEEL

gives parts like these high strength, toughness

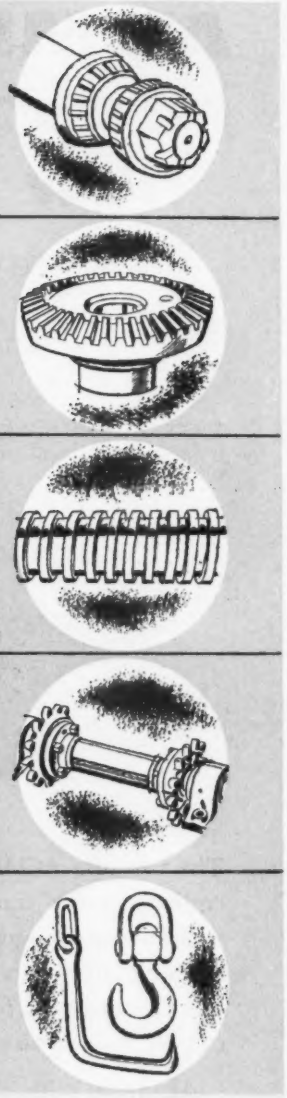
AXLES

GEARS

JACK LIFTING SCREWS

SHAFTS

HANDLING TOOLS



...AND YOU CAN MACHINE EVEN INTRICATE PARTS FROM HEAT-TREATED AND STRESS-RELIEVED BARS

Max-el 3½ is the ideal general-purpose steel for mining and construction shops. It has all the properties needed for rugged applications: toughness, strength, resistance to wear and impact. More than that, you can buy it from your nearby Crucible warehouse in heat-treated and stress-relieved bars — in the diameters and lengths you need — which do not require final heat treatment after machining.

Factors like these enable you to speed up repairs whether you make them in the field or in the shop. As a result, you cut down-time and repair costs — get your equipment back on the line faster. Then, too, parts made of Max-el 3½ last longer even on jobs where they're in continual rugged service.

Because of Crucible's methods of manufacturing and quality control, Max-el 3½ is made in extremely accurate sections and straighter bars, in a complete range of sizes and shapes. All Crucible warehouses carry complete stocks so that, in many cases, you get 24-hour delivery of whatever quantity you need.

Like more information? Write: *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

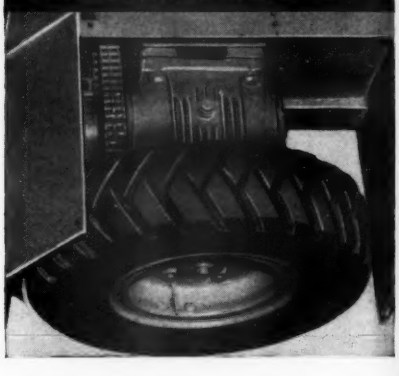
ACME jumbolter now has 4 wheel drive

plus elevating platform for greater manuverability

The ACME Model HSJ-4WD Jumbolter can work an area 23'10" wide without moving. The air-articulated arms reach out 9' in front of the machine.

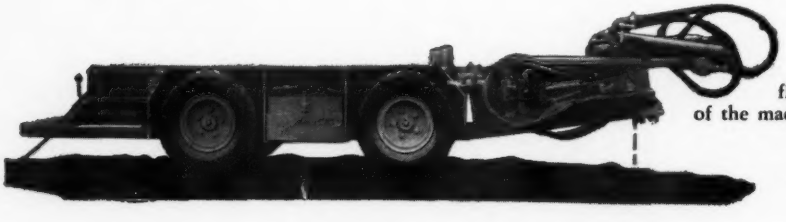
Each arm operates independently and swings 270 degrees.

Each wheel on the ACME Model HSJ-4WD is a driving unit with individual suspension. Large gear reducers are rugged enough to withstand the roughest floor conditions.



The versatile ACME Model HSJ-4WD Jumbolter is now equipped with tractor-type 4 Wheel Drive permitting shorter turning radius. Left hand and right hand wheels are integrated units so that by reversing the wheels on one side while driving forward on the other side the Jumbolter can be made to turn in almost its own length.

Available with either one or two air-articulated arms, each individually controlled, the ACME Jumbolter permits bolting in a wide flexible pattern from 8′ to 10′ back of the working face.



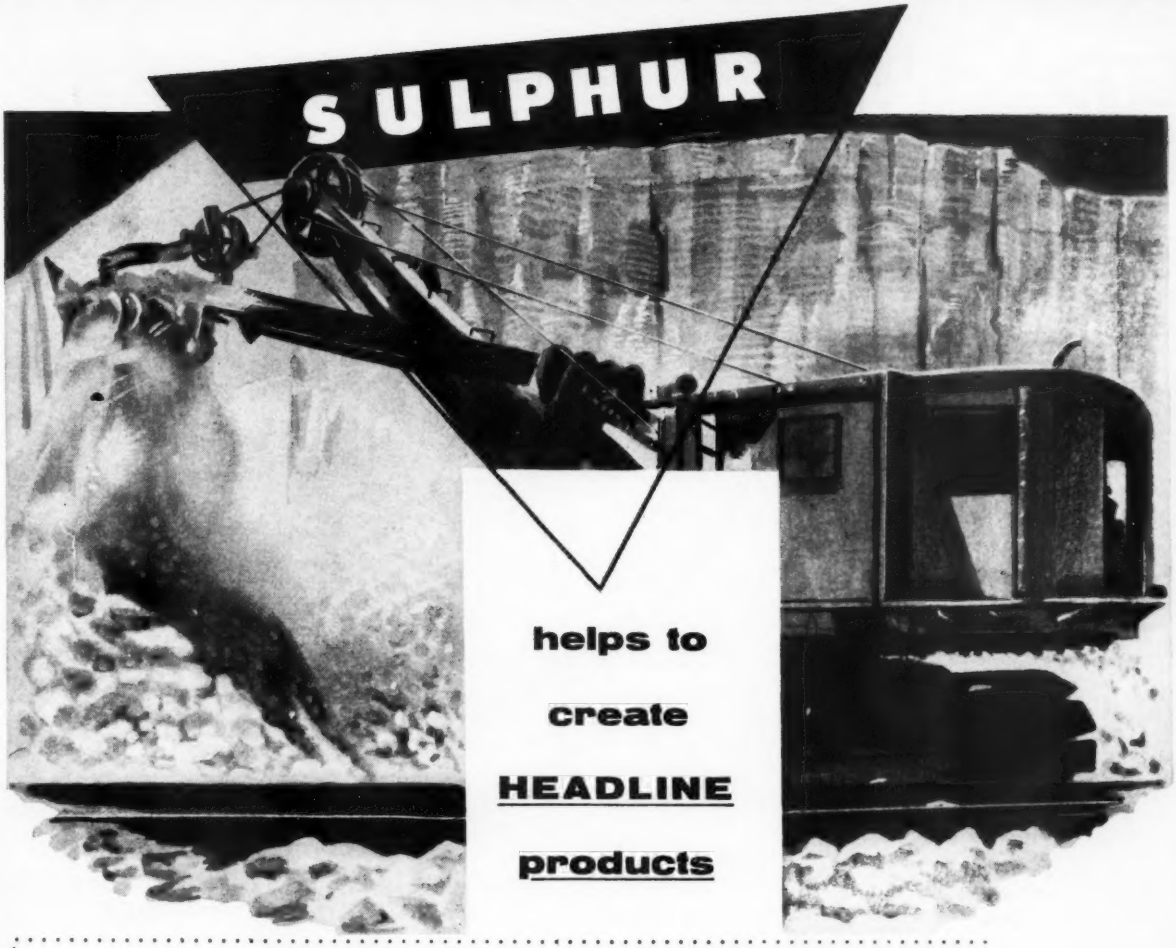
The front platform of the Model HSJ-4WD can be elevated 8" to clear floor obstructions during forward movement of the machine. Hydraulic cylinders raise and lower the platform. A locking device holds platform for in-tram position. Complete details of Model HSJ-4WD are given in Bulletin 4WD.

ACME Machinery Company

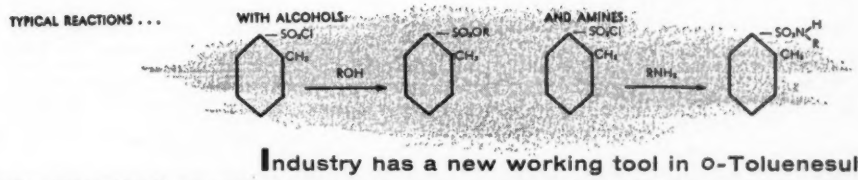
WAREHOUSE & SALES OFFICE
MORGANTOWN, W. VA.

WILLIAMSON, WEST VIRGINIA

REPRESENTATIVES IN PRINCIPAL MINING AREAS



o-TOLUENESULFONYL CHLORIDE*



Industry has a new working tool in o-Toluenesulfonyl Chloride. This 98% pure ortho isomer can be used in building molecules for use in a wide variety of new products, from dyestuffs to pharmaceuticals; from plasticizers to herbicides. It is even possible that it is now being used in products you are making or have recently acquired.

From the chemical name of o-Toluenesulfonyl Chloride it is obvious that sulphur is a component of this compound . . . added evidence of the important role Sulphur plays in our industrial economy.

**Product of Monsanto Chemical Company*

Texas Gulf Sulphur Co.

75 East 45th Street, New York 17, N. Y.
811 Rusk Avenue, Houston 2, Texas

Sulphur Producing Units
- Newgulf, Texas
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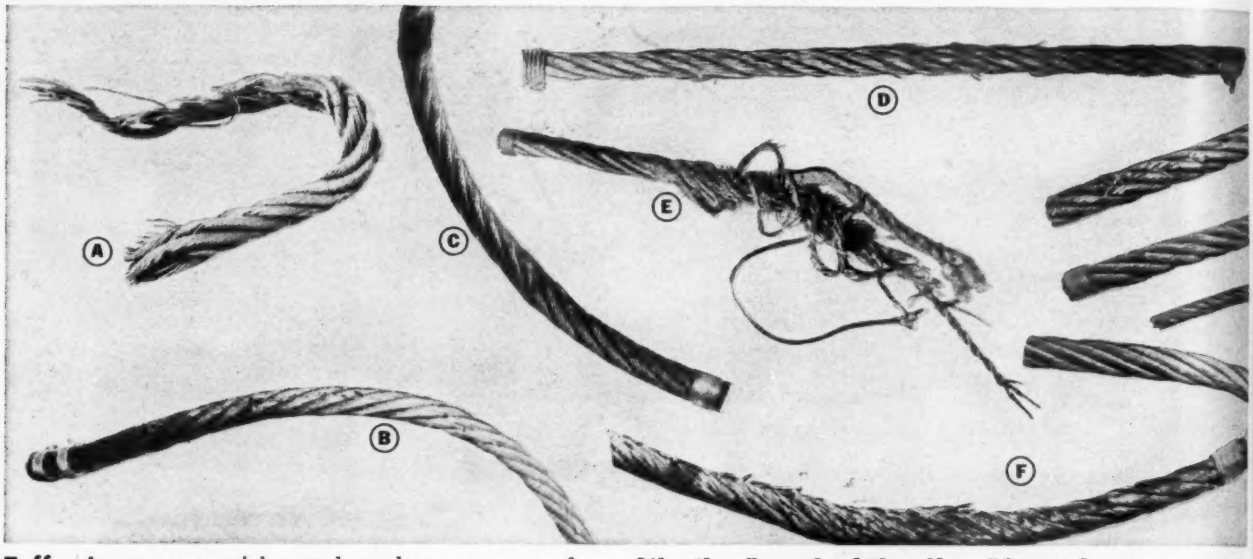
Tuffy Wire Rope Tips



Tuffy gives you a quick run-down here on some of the mortal enemies of wire rope — the abuses that quickly ruin rope efficiency or end its life abruptly long before you have had the service you paid for.

Even the best wire rope is a sitting duck for the enemies which won against the wire rope pictured on these pages. When you avoid or eliminate them you make important gains in longer rope life, better service and greater economy. Remember, your Tuffy distributor will be glad to work with you against these and other wire rope hazards.

It's the "end of the line" for wire rope when these things happen:

A. Mangled in a wedge socket. Here's the result of improper socketing. This fatal rope injury was caused by a poorly designed or worn out wedge socket. Failure at the dead end can damage other sections of the rope.

B. Rusty road to ruin. Rust — No. 1 enemy of steel — takes a heavy toll in wire rope life. It's an insidious, silent type of killer, often doing irreparable damage before it's even noticed. The one-strand break shown above resulted when the rope was allowed to become rust-bound through lack of lubrication. With other conditions ideal, tests show properly lubricated rope has up to 10 times the life expectancy of dry rope.

C. The crushing blow. The Sunday punch for this piece of wire rope was delivered by a tractor cleat — just one of many crushing injuries that result when wire rope is run over or banged into by a hard, sharp object. Even the best rope is no match for this kind of mistreatment.

D. Strangled by misfit sheaves. When the bearing surface of a

Tuffy Special Wire Ropes are tailored to special use. Ordering is easy:

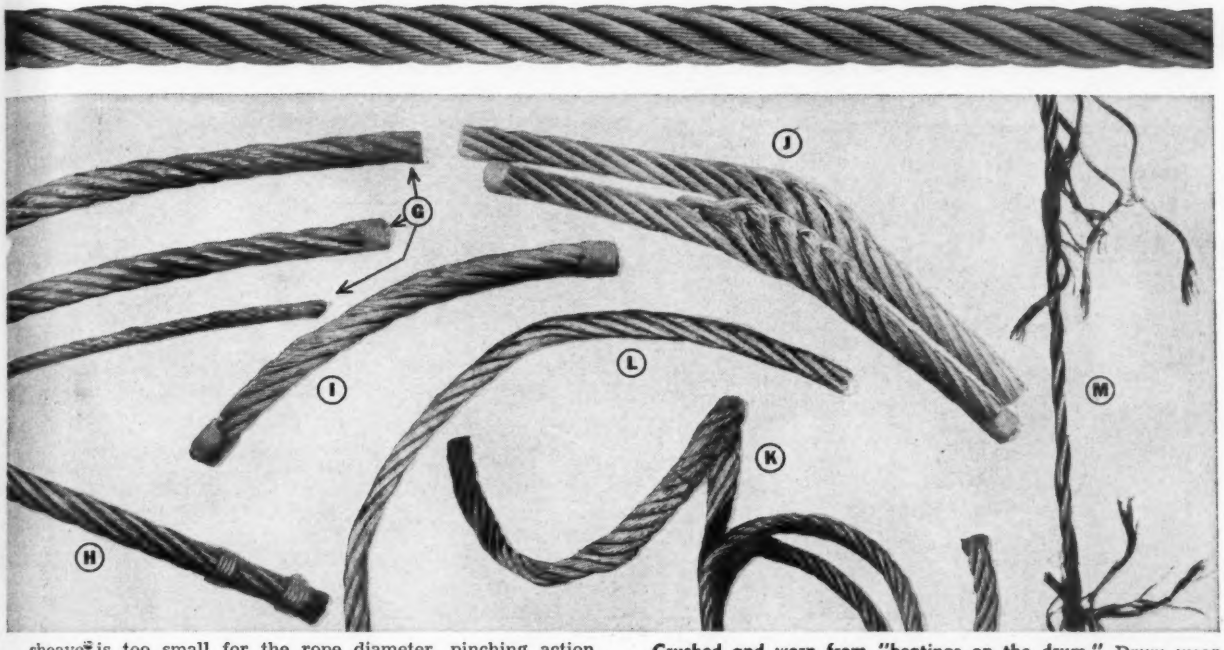
Tuffy Scraper Rope

Moves more yardage per foot because **Tuffy** Scraper Rope is specially built to take the beating of extreme drum-crushing abuse. Flexible; withstands sharp bending; hugs sheave grooves and winds snugly and smoothly on drums. High resistance to load shock on slack line.

Tuffy Dragline Rope

A longer-wearing line for all dragline operations. Special abrasion resisting construction which also gives extra flexibility. Tuffy Draglines also spool better, ride better on grooves and hold tightly to drums when casting. Consistently dependable in handling any material — wet or dry dirt, sand, gravel, rock, cement or minerals.

How wire rope is crippled and killed without a fighting chance



sheave is too small for the rope diameter, pinching action quickly destroys the rope especially when it is overloaded. The one shown above was knocked out in just 1½ hours of service.

E. Apparent suicide! This rope jumped out of sheave and was soon destroyed by pulling around the shaft. Actually it was a case of sudden slack which threw the rope out of the sheave.

F. This rope came to an untimely end by operating over a sheave that did not turn. Note the exceptionally heavy abrasion on one side of the rope.

G. Victim of "the bends." Excessive bending soon wears out rope. Generally, more flexible ropes are used as bending stresses increase (with decrease in tread diameter of sheave or drum). If a rope is operated on a sheave too small for its bending characteristics, early failure is certain. Through an exhaustive series of bending tests, Union engineers have compiled data that you can use to be sure you get the rope construction that will give you the longest service life. Ask about it.

H. On the "blink" from a kink. This open kink resulted from mishandling of wire rope. Guard against kinks by proper winding on the drum. Never pull a loop smaller; always enlarge it, then straighten out the rope.

Crushed and worn from "beatings on the drum." Drum wear gives wire rope severe punishment even under normal operating conditions. This wear is found at the cross-over points and at the flange. Excessive drum crushing results from operating on too large or too small a drum. Here are typical "drum beatings":

I. Cross-over wear

J. Cross-over crushing on drum

K. Drum-crushing on oversized drum

L. Drum-crushing on undersized drum

Although drum wear cannot be eliminated, its effects can be greatly reduced. Under properly engineered procedures, two and three times the service can be obtained from the same line. Union Wire Rope engineers will help you with this problem. Get in touch with us for more information.

M. Overloaded — soon exploded. Wire rope is "prescribed" for a given use on the basis of breaking strength plus a safety factor of 4. The grade of steel, type of construction and size of the rope determine tensile strength. It must be properly related to the loads it will carry, or expensive and dangerous early failures are likely to occur.

Just say **Tuffy** give length and size, and forget complicated specifications.

Tuffy Slings and Hoist Lines

Here's a team that cuts hoisting and down time costs in all types of materials handling.

Tuffy Slings are made of a patented, 9-part machine-braided fabric that stays extra flexible, and isn't materially damaged by knotting or kinking.

Tuffy Hoist Line is a special construction with the extra flexibility and toughness for longer service life on overhead cranes, derricks and clamshells.

Tuffy Dozer Rope

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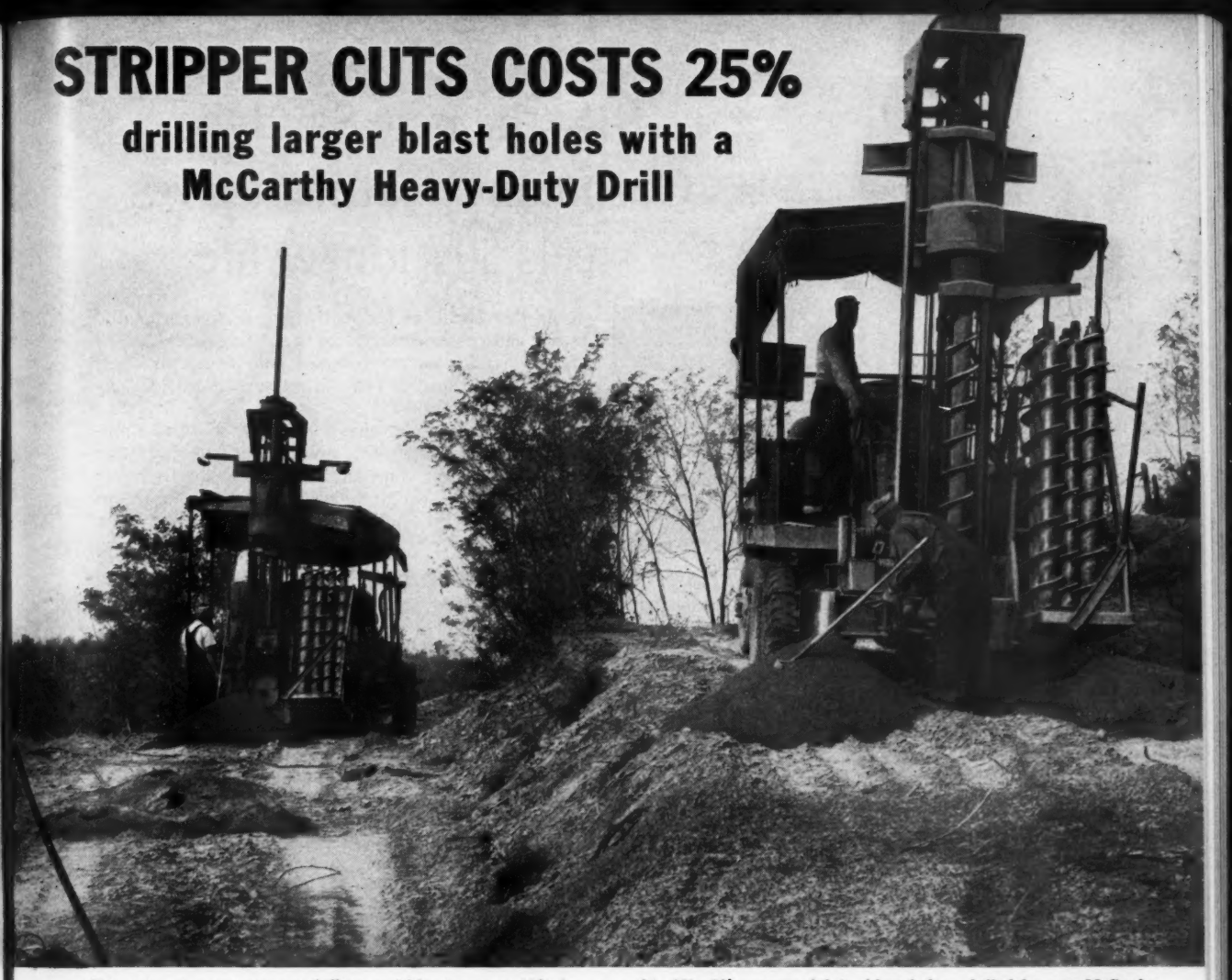
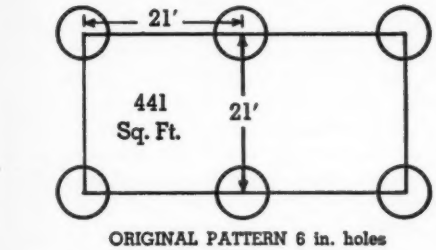
STRIPPER CUTS COSTS 25%

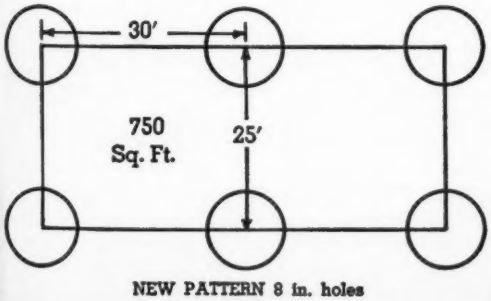
drilling larger blast holes with a McCarthy Heavy-Duty Drill



This strip mine operator cut drilling and blasting costs 25% by using this 25' x 30' pattern of 8 in. blast holes—drilled by two McCarthy Heavy-Duty Vertical Auger Drills.



ORIGINAL PATTERN 6 in. holes



NEW PATTERN 8 in. holes

A Southern Ohio strip mine operator cut his drilling and blasti costs by 25% when he widened the blast hole pattern and switch from 6 in. diam. to 8 in. diam. holes. He used McCarthy Heavy-Du Vertical Auger Drills and a new type of explosive to remove t sandstone overburden.

A cost study made by the operator shows that the McCarthy d bored the 8 in. holes at less cost than the 6 in. holes. Four 6 in. dia holes covered 441 sq. ft. Four 8 in. holes covered 750 sq. ft. Sin fewer 8 in. holes were required to drill the same area, over-all drilli time was cut in half. In each pattern, the amount of hard rock drilli was the same. The study included five work shifts of two McCart Model 106-24 Auger Drills, one using 6 in. and the other using 8 flights. The stripper figured all drilling and blasting costs, includi fuel, labor, bits, explosives, etc. Over-all cost saving was 25%.

McCarthy Heavy-Duty Vertical Auger Drills drill up to 24 in. dia holes faster than any other auger drill. Start cutting your costs nc by phoning the nearest Salem Tool representative. Or write Bulletin M-100.

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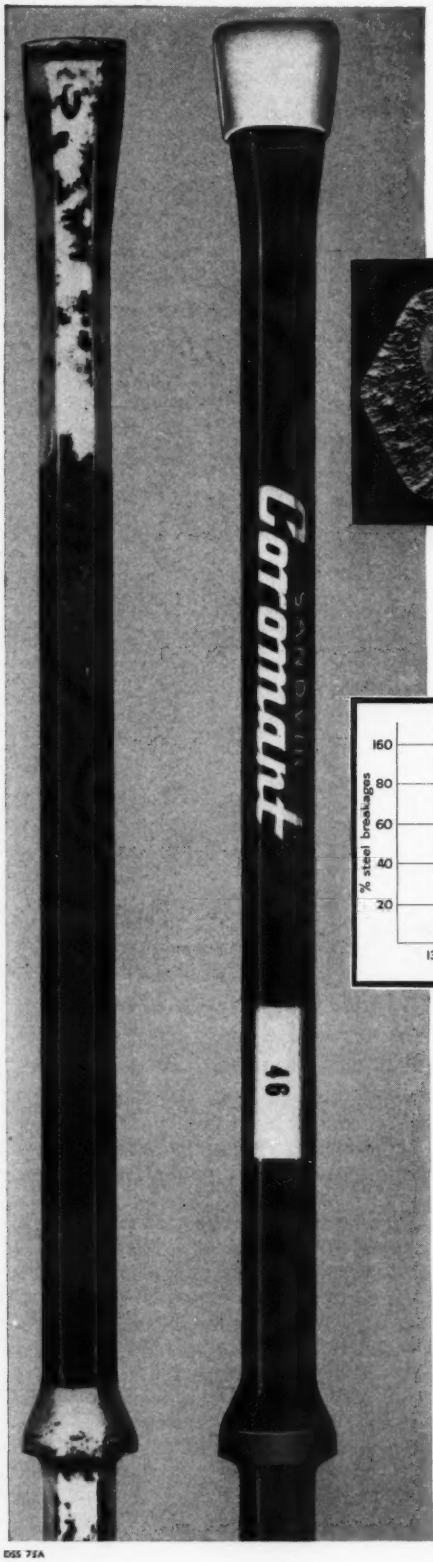
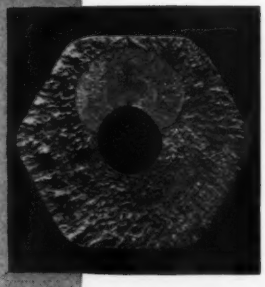


SR—the new Sandvik Coromant treatment gives steels 50% longer life

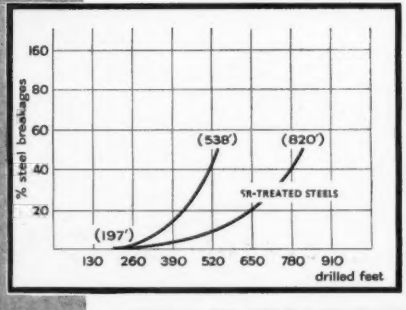


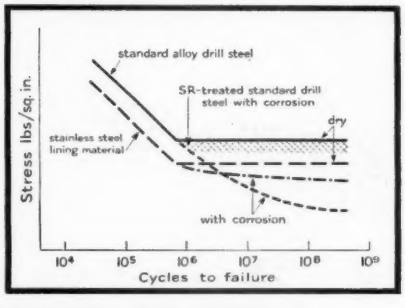
Corrosion invariably lessens the fatigue strength of drill steels and causes earlier breakages. The breakages start from corrosion craters and indentations, around which ever-widening areas of worn surfaces are formed. (See picture of cross-section.)

The main cause of corrosion is moisture—so effective protection of the steels against moisture during both storage and actual drilling eliminates corrosion and gives longer life to the steel. This protection is given to Coromant integral steels by the SR treatment, a new exclusive Sandvik feature.

PRACTICAL TESTS GIVE CONCLUSIVE PROOF

The diagram on the left shows clearly that SR-treated steel rods have a 30%-50% longer working life than those of untreated steels. Figures are based on extensive practical tests, which resulted in an average drilling depth of 820 ft. for SR-treated steels as against 530 ft. for untreated steels, before rod breakage.





HOW SR TREATMENT PREVENTS CORROSION

SR treatment is a new method of surface protection developed by Sandvik. It protects both the wall of the flushing hole and the outer walls from corrosion by a thin but strongly adhesive layer. The fatigue properties of the steels therefore correspond to those valid under dry conditions. On the wall of the centre hole, usually subjected to water flushing, the SR layer is everlasting, and *does not decrease the diameter of the flushing hole*. This is a distinct improvement on the old means of coating the centre hole with stainless steel, which lessens the diameter of the flushing hole, prevents full and effective flushing, and thus diminishes the drilling rate. Moreover, stainless steel has a lower fatigue strength than standard alloy drill steel.

Sandvik Coromant drill steels have been closely developed together with Atlas Copco rock drills. This drilling combination has for years been the most widely used in the world.

Sandvik Coromant integral steels, extension steels and detachable bits are supplied by Atlas Copco, who, in their own field, are the world's largest manufacturers of rock drills. For further information please contact: **U.S.**—Atlas Copco Pacific, Inc., 930 Brittan Avenue, San Carlos, California, Atlas Copco Eastern Inc., P.O. Box 2568, Paterson 25, N.J. **CANADA**—Atlas Copco Canada Limited, Montreal Airport, P.Q. **MEXICO**—Atlas Copco Mexicana S.A., Apartado Postal 56, Torreon, Coahuila.

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EDITORIALS

ROBERT W. VAN EVERA, Editor

JUNE 1957

A PRINCIPLE RECOGNIZED

THE Administration's "long-range minerals program," for which the mining industry has so long been waiting, has just been unveiled before the Senate Committee on Interior and Insular Affairs.

Although it leaves open many of the problems involved, in maintaining a "strong, vigorous and efficient domestic mineral industry," as called for in the November 30, 1954, report of the Cabinet Committee on Minerals policy, it is gratifying to note that as to lead and zinc it recognizes a principle which the mining industry has consistently advocated—the establishment of excise taxes on imports, to become effective when price declines threaten injury to domestic producers, and to be suspended when prices are at an economic level that permits the industry to maintain a reasonable mobilization base.

The adequacy of the proposed import taxes, the prices at which they would be applicable, and the differentials as between imports of metal and concentrates are subject to question and criticism by those best informed on the economics of the industries affected. However, the fact that the principle has been recognized—and concurred in by the various Government departments interested in mineral policy—is an important step forward. It supports the industry's view that stockpiling, either through direct purchases or through barter of surplus farm commodities, is a "stop-gap" or temporary measure—which, although of real help in the last few years, necessarily tends to aggravate the problem of world overproduction. In the light of the critical situation affecting the lead and zinc industries as the result of recent price declines, it is fervently hoped that a suitable import tax measure will be promptly enacted into law—and that it may serve as a pattern for other branches of the mining industry to which similar treatment could be appropriately applied.

Space does not permit a full discussion of other phases of the "long-range minerals program." Producers of various minerals will undoubtedly present their views as to its shortcomings in their respective fields. The general proposals for increased topographic and geologic mapping, basic research, and an expanded program of exploration assistance are commendable and will no doubt receive support. Members of the Senate Committee, however, took occasion to point out that the mere finding and development of new orebodies is of little value if the potential market for the product is preempted by low-cost foreign competition.

As to coal, the Department's report states, "Although the increased program recommended herein applies exclusively to other minerals and metals, expanded research and development effort is needed with respect to fuels. It should be noted at this time that the Department also plans to accelerate programs designed to broaden the Nation's energy resource base." More than two years have elapsed since a special Cabinet Committee outlined the broad principles of a national policy with respect to fuel and energy supplies—of special importance to the solid fuels industry. We trust that concrete action to make these recommendations fully effective will soon be forthcoming.

VIGILANCE REQUIRED

THOSE in Congress who would put the American businessman in an economic strait-jacket are a persistent group. They are often slowed, but never stopped. The best evidence of this currently is the effort to get action on H. R. 11 or its companion bill S. 11.

These bills would, in effect, eliminate the "good faith" defense in lowering prices to meet the equally low price of a competitor—not to cut the price of a competitor, but merely to meet it. The American Mining Congress has pointed out that "adoption of such proposals would serve no useful purpose, but on the contrary would throw doubt and uncertainty into a broad field of lawful and long accepted pricing practices which actually insure competition and thus inure to the benefit of the consumer."

Elimination of the "good faith" defense might well make it difficult, if not impossible, for companies producing such important and widely used products as cement, coal, steel and other mineral commodities to meet a competitor's price without running the risk of violating the law. It could cast serious doubt on certain long accepted and clearly desirable practices of absorbing freight for the purpose of meeting competition.

Similar bills have been introduced in previous sessions of the Congress, but were never enacted into law for a variety of reasons. Undaunted by past failures the advocates of business regulation have introduced the bills again this year, only to see them languish in committee. With the perseverance of dedicated men, the authors of the bills have tried to get action, but to no avail. Now they have resorted to another technique known as the discharge petition.

If and when a majority of the House members (218) sign the petition the bill is brought to the House floor for a vote. It makes no difference whether hearings have been held or how ill-informed the members of the House may be on the subject.

Whether the authors of the bills will get sufficient signatures on the petition is conjectural. Under similar circumstances last year they were successful and the bill passed the House by a resounding vote of 393 to 3, with many of the Congressmen not knowing what they were voting for. One, Rep. Harrison (Rep., Neb.) was actually forthright enough to admit he had made a mistake. In a prepared statement he said, "My only excuse is that if I was misled, so were a lot of my fellow representatives. There were many of us sold a bill of goods, and they were very shabby goods."

Mail will be pouring into congressional offices urging members to sign the discharge petition. Some of it will be "inspired" by zealous advocates and some will be written by sincere citizens who think the bill is worthy. The success or failure of this newest move now rests in the hands of the people at home.

Even if this latest move fails, businessmen will not be able to relax because those seeking measures that would undermine our economic system will only double their future efforts.

Roof Support with Continuous Mining

By BEN TUDOR
Mining Engineer, Compass Division,
Clinchfield Coal Co.

THIS report on roof bolting practices in connection with continuous mining deals with practices presently in use at the Compass No. 1 Mine of the Clinchfield Coal Co., Barbour, County, W. Va. Compass Mine produces an average daily tonnage of 6000 tons. This tonnage is derived from one continuous miner with Joy shuttle car haulage and four conventional mechanical loading units which are composed of Joy loaders, Joy cutting machines, Joy shuttle cars, and Jeffrey roof drills. In addition, there is a Joy 1-CM with an extensible belt with which this report will deal.

"Island Type" Mining Plan

The mine is operating the Pittsburgh Seam of coal. This is about the southern most point in the State of West Virginia where the Pittsburgh coal is mined. Consequently, the mining plan is more or less the "island type" on a large scale as the coal occurs near the top of the hills where the outcroppings have been stripped.

The Pittsburgh Seam in this area averages about eight ft in thickness. About seven ft of coal is taken in the mining operations, with 6 to 12 in. of top coal left to prevent air slackening of the overlying shale top. Roof bolting is used throughout the mine to hold this layer of top coal. Bottom coal is also left because the seam is underlaid by a soft fireclay that disintegrates badly when in contact with water and is not solid enough to support the weight of the continuous miner. The layer of coal left on the bottom is high in ash and sulphur; and since it is not mined, a higher quality raw product is delivered to the cleaning plant.

Conventional and Continuous Units Utilized

In this particular locality the Pittsburgh Seam is cut by numerous clay veins. These veins are highly irregular and have no particular common strike, running at random intervals and directions through the coal seam. The clay veins will vary in thickness from one or two ft up to a maximium of eight or ten ft. Compass tries to be selective in choosing the working sections for the continuous operation so that the miner will not have to cut through an excessive number of clay veins. This is done by plotting the courses of the clay veins that have been found in nearby workings.

Development is usually done with conventional units. Entries 14 ft wide are driven on 60 ft centers while 14 ft cross-cuts are broken every 60 ft. Entries are driven in groups of either 7 or 14, depending on whether there is a single conventional unit or two conventional units side by side. At 90° off of these developed main and submain entries the continuous miner drives headings or probably more accurately termed rooms. These rooms are on 60 ft centers, 17½ ft in width, and are driven up to a maximum distance of 1000 ft. Cross-cut centers vary but usually average about 80 ft.

When one room is driven to its extremity, the belt is left in place. The miner, the extensible tail section, and the extensible head section are trammed over to the adjacent, previously driven room. Belt is already in place there but has to be connected to the head and tail sections. The miner then pillars this room taking everything on say the left side but mining only about ⅓ of the block on the right and next to the developed room. When this room is pillared, the miner leap frogs the previously developed room in which the belt was left in place.

A new room is then driven to its extremity with the belt recovered from the last pillared room as the miner retreated. After this room is developed, the miner head section, and tail section are trammed to the adjacent room where the belt is already in place. The miner then pillars the remaining ⅔ of the block on its left and only ⅓ of the block on the right, thus completing and starting a new cycle of operation.

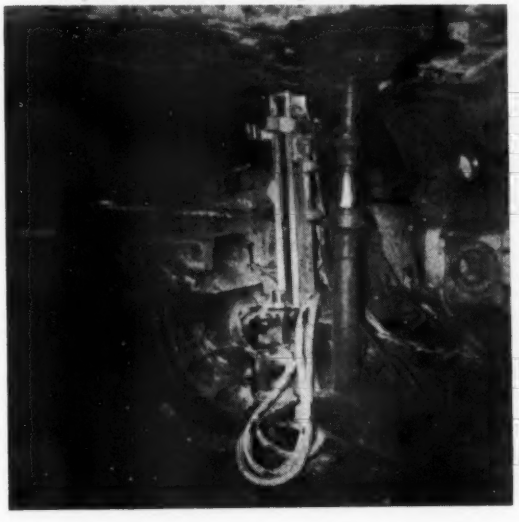
This system is rather unique for it requires only a minimum amount of time to put the belt in operation when the miner and the self propelled head and tail sections are trammed back into a room. It does however require extra belt and stands, but this expenditure is justified by considering fast between shift moving with a minimum of delays by having the belt in place.

Excellent recovery is being obtained with the continuous miner and the extensible belt. About 90 percent of the coal is recovered and good straight pillar breaks occur from the straight pillar line. There is seldom any evidence of weight riding over from the pillar line to the adjoining development.

Six-Man Crew Operates Miner and Extensible Belt

The Joy 1-CM continuous miner is a heavy-duty mobile machine for seams 54 in. or higher and is mounted on independently driven cat-units. This machine and extensible belt went into service at the No. 1 Mine in March 1955 and has certainly made a name for itself when considering some of the adverse working conditions such as clay veins, sulphur balls, and roof which has not always been the best. Tonnage per shift, of course, has varied. With natural conditions at their best, production has exceeded 700 ton per 8 hour shift—portal to portal—but the daily shift average,

◀ Two roof bolting drills are mounted on the caterpillar frame of the continuous miner directly behind the timber jack and the one on the right side (shown) is just in front of the operator's controls



▶ With a tightening wrench placed on the drill, the roof bolt is tightened under slow feed. The relief valve at slow feed cuts off at 1000 psi which develops a torque on the bolts from 150 to 160 ft lb

Compass No. 1 Mine . . .

* Accomplishes roof support without interrupting the loading of the continuous machine by means of two roof bolting drills mounted on the miner

* Utilizes conventional and continuous mining units to produce an average of 6000 tons per day

◀ A roof bolter drills an angular hole to install a bolt on a 20-25° angle (note the 2½ ft extension added to the drill stem). Bolts currently in use are ⅝ in. by 5 ft long

▶ The bolting pattern is staggered down the room on four ft centers and 2¾ ft from the rib, considering only lateral dimension. Approximately one bolt per ft in a 17½ ft wide room is used

taken over a year, is right at 510 tons. Tonnage-wise this is comparable to the conventional units; however, the manpower requirements are only about one-half.

A six man crew and foreman operate the miner and extensible belt. The duties of this crew are as follows: One machine operator, two roof bolters, one mechanic, and two general laborers. The machine operator and two roof bolters handle all the work assignments at the face; the other three men add belt and install intermediate sections in addition to handling miscellaneous jobs such as shoveling spillage, setting safety posts, and rotating roof bolt men for lunch.

In operation, the continuous miner rips out a channel of coal 42 in. wide and 18 in. deep, cutting from bottom to top of seam. Five of these 42 in. cuts make the room width of 17½ ft. Crosscuts are driven half way from each side and are at approximately 90° with the rooms. They are the same width as the rooms. Under normal operating conditions it takes approximately five minutes to make one sweep of the face, resulting in an 18 in. advance for the width of the face.

Type of Roof Drills

To accomplish roof support without interrupting the loading of the continuous machine, two Joy RDU-2 roof bolting drills are mounted on the miner. These are of the auger type and are hydraulically operated. A 26-hp motor and a 4-section hydraulic pump serve as the power unit for the bolting drills which operate independently of the continuous miner; however, their controller switch is synchronized into the miner's off-on switch as a safety feature.

The drills are mounted on the caterpiller frames of the miner directly behind the timber jacks and the one on the right side is just in front of the operators control platform. This location of the drills puts the two roof bolting men the closest to the face, but at that they are approximately 12 ft away. The operator and other men are never exposed to any unbolted roof.

To mount the drills, a specially adapted bumper has been installed on the Joy 1-CM. This bumper has been extended to hold the drill pump motor and pump, and it also supports a drill controller. The location of the miner's water filter has been changed from the center rear to the right side of the bumper and to the operator's left. The component parts of the roof drill are the feed unit, the rotation unit, the hydraulic centralizer assembly, the trunnion support, and the power unit.

The drill feed unit consists of a hydraulic motor driving a worm keyed to the hydraulic motor shaft. This worm in turn drives a worm gear which is splined to a chain drive sprocket. The chain drive sprocket then raises or lowers the entire drill rotation unit up and down a channel. This in turn raises or lowers the drill stem or the tightening wrench as required.

The drill rotation unit consists of a hydraulic motor driving a pinion keyed to the motor shaft. This pinion drives a gear which is keyed to a spindle. The spindle carries a hex extension which mates with the female end of the drill steel and the roof bolt tightening wrench. This entire rotation unit is raised or lowered by the drill feed unit. The speed of rotation is controlled by two valves; one drives at a high speed, while the other drives at a low speed.

The hydraulic centralizer assembly is mounted to the channel frame of the roof bolting drill. It is composed of two centralizer arms which are controlled by a hydraulic piston in a double acting valve. This centralizing assembly serves to position or hold the drill steel in place when the hole is being started. The arms in open position allow the rotation unit to pass through, thus increasing the feed length of the drill.

The trunnion supports the entire unit and is mounted in a bracket which is supported from the side of the caterpillar frame of the miner. One side of the trunnion is flanged while the other side is splined, thus permitting the roof drill to pivot. The degree of tilt or pivot is controlled by double acting valves and a nine-in. brake drum which is circumvented by a brake band. When the drill feed is in operation, the brake is automatically operated to prevent any lateral movement. This trunnion support is designed to let the drills operate 30° in towards the miner from vertical position and 24° outward from vertical.

The power unit for each drill consists of a 26-hp compound wound motor which operates at 1175 rpm. At Compass this motor is operated on 250 volt d-c and drives a four-section hydraulic pump. Composing the four sections are two 2-in. sections and two ¾-in. sections; the two-in. sections operate the fast drill feed, and the drill rotation valve while the ¾-in. sections operate the clamp jack, the slow drill feed, and the tilt boom valve. The drill's hydraulic system is separate from that of the miner's.

In the hydraulic system are two relief valves located on the input side. There is a valve whose cut-off pressure is 1200 psi on the circuit controlling the fast drill feed, and drill rotation. The other valve controls the clamp jack, the slow feed, and the tilt boom. This valve cuts off at 1000 psi.

Drilling Procedure

While the miner is ripping out the coal, the roof bolters on each side of the machine are busy drilling holes and tightening the bolts. The bolting crew follows a definite pattern which is coordinated with the miner's advance.

As the miner removes the first 18-in. cut across the face, each roof bolt man installs a vertical bolt which is approximately 2¾ ft from the rib line. Finishing the first cut and as the miner moves ahead 18 in., the driller on the left side of the machine angles his drill 20° to 25° toward the center of the room and installs a bolt on that angle. This bolt is approximately 6¾ ft from the rib line or 4 ft from the previous bolt, considering only lateral dimension. Following the next 18-in. advance the driller on the right side of the miner puts in a bolt angled toward the center of the room. The dimensions would likewise be the same as for the second bolt.

Following the third advance of the miner, both drillers install two vertical bolts and thus start the cycle again. Hence the bolting pattern is staggered down the room on 4 ft centers and 2¾ ft from the rib, again considering only lateral dimension. Approximately one bolt per ft (in a 17½ ft. wide room) is used. One hundred to 140 bolts per shift, depending on the tonnage, are used.

The type of bolts currently in use are ⅝ in. by 5 ft long with a 1⅜ in. expansion shell. A 6 by 6 by ¼ in. bearing plate is attached to the bottom and hard washers are placed between the bolt heads and bearing plates to reduce friction between the two.

On the angular hole a small triangular, wooden, oak wedge is placed between the bearing plate and the roof. This wooden wedge, placed on the far side of the bolt, serves as a spacer, compensating for the approximate 25° angular difference between the bearing plate and the roof coal. To obtain additional bearing for places in bad roof, 15-in. oak cap pieces are placed between the bearing plate and the roof. In extremely bad places, 4 ft or 12 ft oak boards are bolted to the roof with a consequent change in the bolting pattern.

In drilling, a 4-ft augered stem, 1⅜ in. outside diameter, with a 1⅝-in. Carboloy or Kennametal bit, is used to start the hole. When the driller reaches the limit, the four-ft stem is removed and replaced with a five-ft stem, drilling as high as it can go which is approximately 1½ ft from the top. At this point a 2½-ft extension is added to the stem and the hole is drilled to its entire depth of five ft.

(Continued on page 68)

ANACONDA'S JACKPILE MINE

This report on the Jackpile Mine, from early exploration to present day operations, describes methods and equipment used to develop a sizable, low-cost operation. Of interest is the part played by the Laguna Indians upon whose land the deposit was found

By

ALBERT J. FITCH
Manager, New Mexico Operations
and
JOHN P. HERNDON
Mine Superintendent, Jackpile Mine
The Anaconda Company

THE Jackpile uranium mine, operated by The Anaconda Company, is located on the Laguna Indian Reservation, Valencia County, N. M. It is approximately eight miles north of the Pueblo of Laguna, which is situated on Highway 66 some 45 miles west of Albuquerque.

The discovery of the Jackpile deposit was an outgrowth of Anaconda's intense exploration activities in the Grants, N. M., area beginning in 1950, shortly after the discovery of the Santa Fe Railroad Company's Haystack deposit by an Indian named Paddy Martinez.

Practically all of the ore deposits discovered in the early part of 1951 existed in the Todilto Limestone, the host rock for the Haystack find, as nearly all prospecting was restricted to that particular formation at that time. The Todilto formation in the Grants area is a very gently dipping limestone bed of the late Jurassic Age, lying below the Morrison formation. It is generally not more than 20 ft thick and, with the exception of the Haystack find, its ore deposits are comparatively small and very irregular.

Aerial Prospecting

Anaconda's local management recognized the worth of prospecting from the air early in the game and, as a consequence, started a systematic program of air exploration. All anomalies indicated by the readings of the airborne instrument were carefully plotted on geologic maps of appropriate scale.

Results were rather discouraging in the area surrounding the Haystack deposit and it appeared for a long time that the best that could be hoped for would be the discovery of numerous small deposits of limited tonnage.

During the summer of 1951 Anaconda's exploration activities shifted to the Laguna Indian Reservation, some 50 miles east of Grants, where there were several miles of Todilto outcrops south of U. S. Highway 66. A prospecting agreement covering a major portion of the Reservation was entered into with the Lagunas and an intensive aerial prospecting program was started on the Todilto.

The airborne instrument revealed only a few, widely scattered showings and, while ground crews entered the area to sample and map them, the aerial activity was shifted to the Morrison formation lying a few miles to the north.

Early one morning during November 1951, while skimming down a canyon between two mesas, the airborne observer picked up the hottest anomaly that he had read since the program had started. This was the birth of the Jackpile Mine.

The airplane pilot, who sometimes refer to hills as "piles," named the new discovery Jackpile, in honor of Jack Knaebel, who was manager of Anaconda's New Mexico Operations until July 1, 1956.

Nature of Ore Occurrences

Jackpile ore occurs in irregular, tabular bodies of medium-grained, carbonaceous sandstone, ranging in color from yellowish gray to black. They are located in the so-called Jackpile Sandstone unit of the Brushy Basin member of the Morrison formation, approximately 100 ft below the Morrison-Dakota contact.

Generally, there are two ore horizons, each varying in thickness from a few inches to 20 ft or more, separated by a lowgrade, and sometimes barren, sandstone member. This intermediate sandstone member varies in thickness up to 30 ft, except in a few irregular areas where it is absent. In those areas the ore sometimes reaches a total thickness of 50 ft or more.

The lateral dimensions of the Jackpile mineralization, although not yet fully determined, measure roughly 1000 ft by 6000 ft. The waste overburden, from the top of the mesa down to the ore, varies from 100 ft at the shallowest to more than 300 ft at the deepest. The orebody, itself, is not much smaller in lateral extent than the mesa which contains it, yet it had only one small outcrop—that which the airborne crew found.

33,000 Ft of Drilling

Exploratory drilling was started on the new discovery to determine its extent. After some discouragement, a penetration was made which indicated values and thicknesses of major importance and with this as a base, a drilling grid was promptly started. Holes were originally spaced on 100-ft centers, but were eventually brought in to form squares of 50 ft. Diamond core drills under contract were used, augmented by truck-mounted rotary air blast drills operated by company personnel. Sample intervals were held to a maximum of two ft with radiometric assays being made from the surface to the bottom of the holes. Chemical analyses were made of the samples in the mineralized horizons only.

After about 33,000 ft of drilling, an orebody some 250 ft wide by 800 ft long was indicated with a thickness

of a few to as much as 50 ft. Overburden averaged about 110 ft.

Underground Program

In order to verify the drilling results, an underground program was initiated. Three tunnels were driven in strategic locations, one in the ore horizon and two some 30 ft below the ore, with certain drill holes for targets. These headings were large enough to permit the use of a 1¼-yd diesel tractor loader for muck handling purposes; drilling was done with jacklegs and jackhammers.

When the drill hole objectives were reached, raises were established through the ore. The material obtained from this work was carefully shipped in its entirety as bulk samples to the Bluewater Plant where it was mechanically sampled, assayed and metallurgically tested. In addition to the bulk sampling, each raise was mapped geologically and blanket sampled. All information thus obtained was correlated and compared with the original drilling conclusions. It is interesting to note that the blanket sampling produced results slightly lower and the bulk sampling somewhat higher than the sampling of the diamond drill cores.

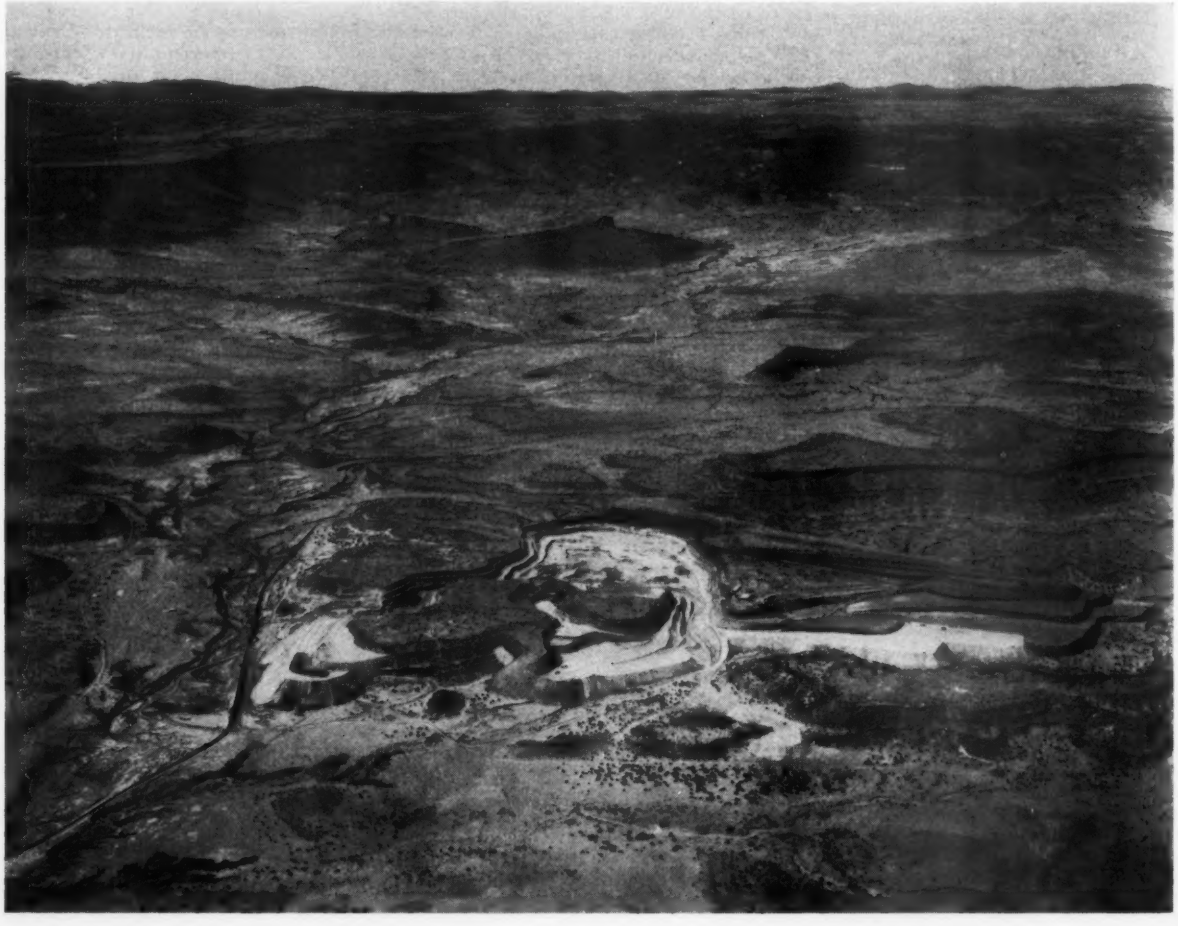
The underground work offered an opportunity, in addition to obtaining sample information, to gather data on water conditions, type of ground, ground support requisites and other things of like nature, knowledge of which is necessary in determining the potential working conditions that must be evaluated in planning a mining operation.

The decision was made to extract the deposit by open-pit mining in spite of a waste to ore ratio of approximately eight to one. It was calculated that possibly 40 per cent loss of the total ore reserves would be incurred by underground methods because of the weak ground and the irregularity of the orebody. The presence of a diabase sill, or dike, about five ft thick which in places overlay and in others cut through the ore complicated matters. It was felt that this barren material had to be selected and discarded because, by its introduction into a mill circuit, both mechanical and metallurgical complications would occur. This coupled with the erratic nature of the deposit indicated a rather high degree of selective mining. Open pit methods promised substantially complete extraction with the possibility that unknown ore would be discovered during the actual mining.

First Mining Operation

A contract was consequently given to the Isbell Construction Co. in the latter part of 1953 for stripping of overburden down to within about 20 to 25 ft of the mineralized zone. Benches were established at 40-ft intervals with two 2½-yd diesel shovels and suf-

Anaconda's famous Jackpile Mine, prospected from the air, presented many challenges to the technical and personal ingenuity of the crews that worked on it.



ficient supporting equipment to serve the operation.

Anaconda followed below with the removal of the remaining overburden. Ore production, on a limited scale, started several months later and shipments were made to the ore-buying station at Bluewater.

It quickly became evident that extreme selectivity would have to be exercised, much more than originally anticipated. The spotty nature of values and the irregularity of the deposit exceeded expectations, and the diabase sill offered a real mining problem—local folds and abrupt dip changes were all too common with significant concentrations of high grade ore being evident on both diabase-sandstone contacts.

Drilling of the waste bench above the ore was carried out with truck-mounted rotary air blast drills. All diabase stripping and most of the ore was drilled with jackhammers because of the inability to maintain uniform levels. Mining faces varied from 20 ft to a minimum of 5 ft in height, and blasting was done with 40 percent free-running bag powder in the rotary holes and 1⅛-in. 40 percent dynamite in the jackhammer holes. Waste material was loaded out with a two-yd diesel tractor loader into six-ton gravity-dump trucks. Ore was loaded by front loader directly into highway trailer-type trucks of 15-ton capacity for hauling to Bluewater, 52 miles away.

About the end of the year of 1954 the above equipment was supplemented by a 1½-yd shovel and several 22-ton end-dump trucks, as the waste haul distance had, by that time, exceeded the economical limit of the smaller, more versatile gravity-dump trucks.

Prospecting and Developing Additional Ore

In the meantime an active campaign of diamond and rotary drilling was continued on an extended grid pattern to the north, and away from the known orebody. Encouraging results took form after many feet of drilling and soon it became evident that an orebody existed which dwarfed the original find and which eventually was to be called a multi-million ton deposit.

A pilot mill was erected at Bluewater to aid in the final design of a plant to treat Jackpile ore and bulk samples were again desired in order to check the drill sampling as well as to furnish information on the metallurgy of the new orebody. Time was important as certain construction plans and commitments had been made. A 7° incline was laid out to be driven into the north orebody with the least possible delay in order to obtain samples from several critical diamond drill hole locations.

With crews working around the clock this heading was driven 350 ft in two weeks. A 1¼-yd diesel tractor loader with exhaust conditioner was utilized for mucking and tramming purposes and jacklegs with jackhammers accomplished the drilling. Each shift was composed of a leadman and four miners.

Upon confirmation of drill hole results by this underground work, a second and larger pit was drawn up on the drafting boards, using the drill hole data for establishing the pit boundaries. Sampling technique and other field procedure had not varied to any degree from that used in drilling out the original orebody. The accuracy of the methods employed had been verified by comparing a calculated tonnage and grade from a mined-out area with the actual tonnage and grade of material shipped to the ore-buying station at Bluewater. The calculated tonnage and grade computed from sections and drill hole assays gave an estimate which proved to be 2.3 percent high on tonnage and 0.4 percent low on grade as compared with actual shipments from the area.

Second Mining Operation

The Isbell Construction Co. was given an additional contract which involved about 15,000,000 tons of waste stripping in the second pit. They moved in during the first part of 1955 with two 5-yd electric shovels and associated equipment capable of moving approximately 700,000 tons of overburden per month. As in the first pit, benches were established at 40-ft intervals with the Isbell Co. operating on the upper benches and Anaconda removing the remaining material lying immediately above the ore. Advance stripping under the Isbell contract was completed October 1956, and thereafter all stripping was handled on company account.

Anaconda continued with its limited production out of the first pit and, as stripping progressed in the second, it followed with a slot in the ore. In order to accomplish the latter work and prepare for future production, additional 2½-yd and 1½-yd shovels were purchased as well as supplementary equipment such as trucks, graders and bulldozers.

As development progressed, it became evident that sufficient tonnage was available to warrant construction of a spur railroad from the Santa Fe main line to the mine, a distance of approximately five miles. Construction of this project started during September 1955 and was completed by the end of the year. It involved the laying of 4½ miles of single track, the construction of a trestle, the diverting of the main drainage arroyo in two places and the installation of 3700 ft of double track at the loading site, with a system of switches and crossovers which offers maximum flexibility in handling railroad cars. The double track grade was carefully established to enable safe gravity carloading without locomotive aid and with a minimum number of personnel.

Equipment Used

In the meantime sufficient ore in the area between the pits had been found, by drilling, to justify connecting them. This work was accomplished in order to aid the handling of ore directly to the crushing and loading plant at the spur track. The loading equipment consists of an 80-ton hopper, 48-in. pan feeder, 42 by 48 in. jaw crusher and a 425 ft by 48 in. belt conveyor. This equipment is supplemented by a weightometer complete with remote control stations, or micro-counters, established at the control panel located on top of the hopper and crusher installation. A system of lights, signal horns and electrical control switches enables three men to crush and load an average of five cars an hour at a cost of approximately three cents per ton.

With the completion of the new mill at Bluewater at the beginning of 1956, mine production was increased rapidly and Anaconda purchased and put into operation the following additional equipment:

1 5-yd electric shovel
1 500-kw mobile power plant
1 3-yd diesel shovel
Sufficient 22-ton dump trucks to bring the truck fleet up to 17
3 rotary air blast drills
1 rubber-tired bulldozer
Fuel truck and other miscellaneous equipment

All ore production is being carried on with two 1½-yd shovels and four 22-ton trucks, with the balance of the equipment being utilized in stripping.

Sampling

It quickly became apparent, in the operation of the new mill, that a careful blend of ores at the mine would be necessary to insure mill feed of uniform grade and metallurgical characteristics. Initial mining control is obtained from the original exploratory drilling which was established on 50 by 200 ft grid systems.

From the waste bench directly above the mineralized zone, supplementary sample drilling by truck-mounted rotary air blast drills is done on narrower sections which have been established throughout the area. Hole spacing varies from 25 to 50 ft, depending upon the consistency and correlation of the data obtained from the original drilling. These holes pass through the ore zone with samples being taken on five-ft intervals. Radiometric assay results are plotted on final sections and correlated with all obtainable data. These assays are almost entirely relied upon, although if there is any reason to doubt their accuracy chemical assays are obtained of the areas in question.

From all this information a picture,

ALBERT J. FITCH was with U. S. Smelting Refining & Mining Co. at Bayard, N. M., from 1936 to 1951 on exploration and mining. Since 1951 he has served The Anaconda Company, New Mexico Operations, as mine superintendent, general superintendent, assistant manager and manager.

Educated at the University of Arizona, JOHN P. HERNDON subsequently was employed as a mining engineer by the Empire Zinc Co., Hanover, N. M. (1928-1930), and Cerro de Pasco Copper Corp., Morococha, Peru (1930-1932). Later, 1937-1941, he

A. J. Fitch

J. P. Herndon

served as resident manager of the Batong Buhay Gold Mines, Philippine Islands. From 1941 to 1947 he was self-employed—leasing and contracting, underground, in southwestern United States.

Other positions include mining engineer, Anaconda Copper Co., Brazil and British Guiana, S. A. (1947-1950); exploration engineer, Societe La Tiebaghi, New Caledonia (1952-1953); and his present job of mine superintendent, The Anaconda Co., New Mexico Operations, Grants, N. M.

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or pattern, is made as to the shape, grade, thickness and existence of the ore and an intelligent, comparatively long range mining plan is made which takes into consideration many operating factors. From the drilling knowledge it is found that the deposit is extremely erratic as to shape, thickness and grade.

Bottom Cutoff Point of Blast Holes—0.03 Percent U_3O_8

The next phase of the operation is the disposal of the material which lies directly on top of the lowgrade horizon above the ore. For this objective any material assaying 0.02 percent U_3O_8 or below is considered valueless. Four and one-fourth inch blast holes are drilled on 8 to 12-ft centers, depending upon the mining face height. All holes are probed with counters and occasionally are sampled if there is any reason to doubt the accuracy of the probe results. Probe readings, taken every two ft, are placed upon a card which is left at each hole collar. After the round is drilled out the grade control engineer inspects each card and marks the depth for blasting, using for the bottom cutoff point any material that is estimated to run 0.03 percent or better over any appreciable distance. The round is then blasted and removed from the pit, being checked closely with a geiger counter in order to safeguard against the possibility of removing ore which might not have been spotted by the blast hole probings. The level thus established is very uneven as it follows the top of the lowgrade as closely as possible.

In some places there is no further stripping to be done because of the relative thinness of the remaining overburden and the proximity of the ore to the exposed surface. In other areas there is a considerable thickness of material classed as lowgrade which must be removed in order to expose mineable ore. Anything under 6 ft of this class of material is considered too shallow to warrant separate handling unless there is a considerable volume involved. Usually these areas are isolated and comparatively small. The places that do have a mantle of lowgrade that must be removed are again drilled, probed, marked and blasted in the same manner as previously described, except that considerably more sampling from collar to bottom of the hole is carried out in order to more accurately determine the assay value of material to be broken, for when it is removed from the pit it must be stored in the proper stockpile according to its grade. Each truckload is counted, probed and grabsampled and then directed to the proper dumping area. The average probe readings govern this distribution, but frequently during the shift the grab samples are rushed through the splitting, crushing and radiometric assaying procedure in order to check the reliability of the probe control.

Stockpiling

After completion of these stripping operations the areas thus treated are ready for mining and shipping or stockpiling. Blast holes 4¼ in. in diameter are drilled on eight-ft centers in order to obtain the maximum shattering possible without scattering. Holes are sampled from collar to blasting depth with the bottom of the ore being determined by geiger probe readings made at the time of drilling. Blasting is usually delayed until all results are obtained by the grade control engineer who plots the data on the workmap, calculates the expected tonnage and grade from the shot, and then marks the holes for blasting.

Several faces of broken ore are available for shipping purposes at the same time, usually of different values. This allows a blend to be made at the hopper in order to obtain, as closely as possible, a uniform shipping grade. In the event that the grade of the material blasted does not allow for shipment at that time, and mining operations demand that it be removed, the material is sent to one of several ore stockpiles. These stockpiles are reduced by blending them with ore from the pit as the opportunity presents itself. In the past 2½ years there have been 11 different stockpiles of five separate ore grades established. Tonnages to these stockpiles have varied from a few thousand to as high as 50,000 tons. Total tonnage hauled to stockpiles has amounted to about ⅓ of the current total ore shipments. To date, about 15 percent of this material has been shipped. As enlargement of the pit permits greater range of available ore grade, it is anticipated that the necessity of temporary stockpiling will decrease considerably and that the current stockpiles will be further reduced.

At the present time each railroad carload is grabsampled and a composite sample is made of each ten cars. The mill superintendent is notified well in advance as to the expected grade of each trainload as an aid to metallurgical control.

Part Played by Laguna Indians

Any description of the Jackpile mine operation would be incomplete without at least touching upon the part the Laguna Indians have played in the development and operation of this large and ultra-important source of uranium.

Early negotiations by The Anaconda Company with the Lagunas established the right of the latter to benefit from the development of the orebody that was found to exist on the land granted to them by the Government of the United States of America. This right was not restricted to royalties or monetary proceeds which would normally be received by any owner who leases or otherwise makes his property available to production. It was recognized that they should receive benefits individually from employment wherever such was possible.

Three years ago these people were completely unfamiliar with the work and equipment associated with a mining operation. Today, at Jackpile, one will find Laguna Indians efficiently holding their own as heavy equipment operators. They have been taught to operate shovels, cranes, trucks, drills, bulldozers and other types of equipment common to open pit mining. All equipment operation is handled by these men, under the direction of a few competent and experienced supervisors. To a marked degree the success of the Jackpile Mine as a sizeable, low-cost operation, is due to the aptitude of these people upon whose land a deposit was found, which has and will contribute much to the uranium requirements of the United States.

Built Big for Big Hauls

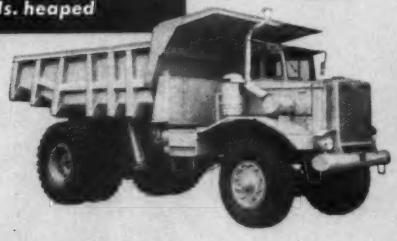
EXTRA RUGGED FOR ALL ROCK AND ORE MOVING JOBS

These rugged movers are built big *all over!* Ton for ton, Kenworth end-dump trucks have greater strength for longer life and less maintenance. Engineered for more driver comfort, safety and control, these production builders are spring mounted—supply unsurpassed visibility and dime-sized turning radius. Extra rugged, their variable section frames are designed to provide deepest sections at points of greatest loading stress. Front axles are just plain big—you can't bend them! Kenworth designed, full floating rear axles are over-sized too.

Built to last—their reinforced, all-welded, box-section-ribbed steel dump bodies hold up in service. Twin, fast-acting telescopic hoists, in combination with load equalizers, provide positive stability. Stem to stern, Kenworth builds 'em big—to deliver maximum performance on the toughest jobs!

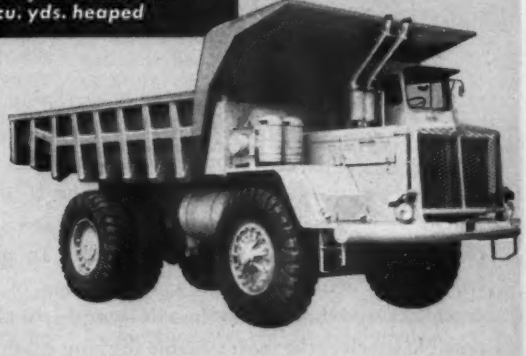
KENWORTH 801
12 cu. yds. struck—
14 cu. yds. heaped
18-TON

KENWORTH 802
16 cu. yds. struck—
19 cu. yds. heaped
24-TON



KENWORTH 802B
32 cu. yds. struck
48-TON

KENWORTH 803
24 cu. yds. struck—
28 cu. yds. heaped
36-TON



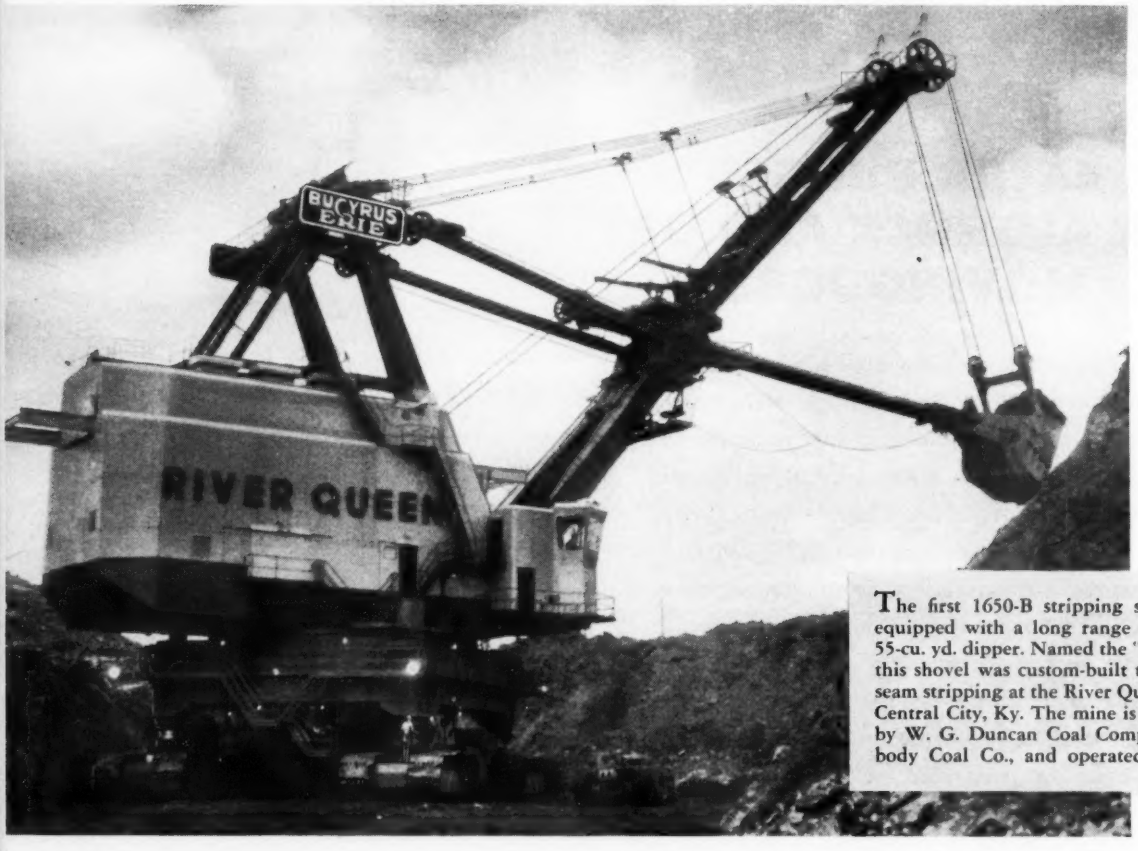
KENWORTH
MOTOR TRUCKS

ANNOUNCING *another mark of leadership!*

Bucyrus-Erie's New

1650-B STRIPPING SHOVEL

with 40- to 65-cu. yd. dippers



The first 1650-B stripping shovel built is equipped with a long range front end and 55-cu. yd. dipper. Named the "River Queen," this shovel was custom-built to handle dual seam stripping at the River Queen mine near Central City, Ky. The mine is owned jointly by W. G. Duncan Coal Company and Peabody Coal Co., and operated by Peabody.

The new Bucyrus-Erie 1650-B stripping shovel offers a practical solution to a familiar stripping problem — economical coal recovery in the face of increasingly high overburden ratios. The 1650-B provides the necessary capacity and digging and spoiling range for efficient, big volume stripping. In addition, its unique flexibility offers a wide range of dipper capacities and boom and handle lengths, making it possible to select the most suitable digging combination for specific needs.

The 1650-B is available with 40- to 65-cu. yd. dippers, with dumping reach ranging from 178 to 135 feet. The machine illustrated here has a 55-cu. yd. dipper and a dumping radius of 147½ feet.

In every detail of its design, this electric-powered stripper is quality-built in the finest Bucyrus-Erie tradition. Throughout its history, the company has devoted its resources to the design and production of machines combining maximum long-time performance with minimum maintenance costs. As a result, Bucyrus-Erie stripping shovels and walking draglines have the range, capacity, speed and reliability to provide consistently high output at low operating cost. Their popularity attests to Bucyrus-Erie's leadership in stripping shovel design.

Let us help you with your stripping problems. We offer a complete line of stripping shovels and walking draglines from 2½- to 65-cu. yd. capacities.

164157C

BUCYRUS-ERIE COMPANY

BUCYRUS ERIE

South Milwaukee, Wisconsin

TRENDS

in

Modern Cleaning Plant Design

Over 18,000 tph of plant capacity for cleaning or for fine coal recovery were added or contracted for by coal companies in 1956, and indications are that even more capacity will be added or contracted in 1957. With increased mechanization of mines and mining of lower quality seams of coal creating new problems in cleaning plant design, trends in processes and equipment are of intense interest to the industry

By
LOY A. UPDEGRAFF
Project Engineer
Bituminous Coal Research, Inc.

TO keep coal competitive with other fuels in spite of rising labor and transportation costs, it has been necessary for the coal producing companies to provide the means of increasing tonnage output per man. In 1956 the average coal output was a fraction over ten tons per miner employed as compared to six tons per miner ten years ago. This has been made possible by increased mechanization of the mines. With the use of mechanical mining machines came adoption of full seam mining with everything being loaded and sent to the cleaning plant. This increased production but also increased the problem of designing and building preparation plants capable of handling the increased amount of rejects and fines and of making a finished product acceptable to the market.

Capital investment cost per ton hour of cleaning plant capacity continues to rise steadily as the problem of cleaning and preparing the coal becomes more complex. The cleaning problem becomes especially difficult when a low grade seam of coal is mined and it is necessary to upgrade it to meet competition from better quality seams. Another source of trouble is the constantly increasing percentage of fines produced as mine mechanization becomes more complete.

More rigid enforcement of stream and air pollution laws necessitates additional equipment for clarifying water and providing efficient dust collection. These features alone sometimes account for as much as 25 percent of the capital cost of a cleaning plant.

However, if it is necessary to provide water clarification or dust collection equipment, recovery of valuable fine coal will often be sufficient to make the investment profitable. In places where fresh water supply is a major problem, clarification of the washery water for re-use in the plant will alleviate such a problem as well as decrease the cost of pumping from an outside source.

Mining and Market Trends

Before considering the subject of "Trends in Modern Cleaning Plant Design," it might be well to first consider some of the trends that have an important bearing upon the design of such a plant. A thorough knowledge of such factors as mining methods, geographical location, seam characteristics, state or Federal air and stream pollution laws in that area, and ultimate market demands for the end products are essential when considering the enlargement of an existing plant or the building of a new one.

Although there is a diversity of opinion as to how fast or how long the demand for coal will continue to increase, it is generally agreed that the foreseeable future looks very encouraging for the industry. The upsurge in demand for bituminous coal has been due primarily to the rapid expansion of the electric utilities industry, the constantly increasing production of steel, and a great increase in export trade. Indications are that the peak has not been reached in any of these markets and the trend will continue upward for the next several years. Electric utilities consumed 156,000,000 tons of coal in 1956 and are expected to consume 166,000,000 tons in 1957.

Steel mills may not expand their output as rapidly as has been anticipated, but some expansion will take place, possibly 10 to 11 percent, within the next three years. This will result in continued increase in demand for metallurgical coal for steel production.

Assuming that coal will continue to hold its share of the energy market as it has during the past three years, the anticipated future increase in demand for energy will require increased production of coal to fulfill its share of this demand. As the demand increases,

In this plant, 6 by 3/16 in. product is washed by dense media—3/16 by 0 in. is screened out raw. The washed coal is crushed to two in. size, mixed with minus 3/16 in., and loaded as one size

some existing mines not now operating will be reactivated and new ones developed. This will result in many present cleaning plants being enlarged or modernized as well as new ones built.

Foreign Outlook

Steel production in Europe will expand much more rapidly than in this country. By 1960 France, Great Britain, and Germany will have doubled their highest output of steel prior to World War II, which, when reached, will require the purchase of about 20,000,000 additional tons of metallurgical coal from the United States to help meet their requirements.

It is estimated that a total of 55,000,000 tons of coal will be exported to foreign countries other than Canada in 1957 and may reach 70,000,000 tons by 1960. This coal will have to be processed through cleaning plants to meet certain requirements as to ash, sulfur, and moisture content.

Since the European Coal and Steel Community was formed in 1952, steel production in those six countries has increased by 300 per cent, but coal production has increased only one per cent in that period. As a result, 30,000,000 tons of metallurgical coal have had to be imported to take care of this expansion. Every possible means is used to conserve their metallurgical coal resources and their preparation plants are designed to get every available pound of good coal out of the material coming from the mines. Various types of washing units are in use and froth flotation for the upgrading and recovery of fines is common practice and has been in general use for many years. In Great Britain alone over 2,500,000 tons of fine coal, 60 mesh by 240 mesh, are cleaned each year by the froth flotation method.

The dense media process in which either magnetite or suspended refuse is used as a cleaning medium has gained wide acceptance, and the use of middlings and high ash salvaged coal for steam generation is common practice.

Due to the high price of fuels in Europe, electric power costs are much higher than in this country, so the development of atomic power can be expected to proceed much more rapidly and thus become competitive with other fuels much sooner there than here. Large scale use of atomic power for industrial uses will become a reality abroad as money, materials, and technical know how become available. Just how soon that era arrives is a matter of speculation, but its effect on the export of coal from this country should not be felt for at least a few more years. The factor that could effect the export market more quickly than atomic power would be a disproportionate increase in the selling price of coal and higher freight rates to destination as compared to other fuels.

At the present time coal costs 2½ times as much in Europe as in this country, yet wages there are lower, resulting in less money to buy it. As the price of coal increases, the incentive to change to other fuels gets stronger, so unless the prices of other fuels advance at least as rapidly as coal, they will eventually reduce the demand for imported coal in that area. American coal producers will have to use every possible means to keep down mining and preparation costs if they hope to retain this export market.

In England and France metallurgical coals are reserved for that particular use, while in Holland and Germany strongly caking coals produced there are used for other purposes as well as for metallurgical uses. Research for better mechanical cleaning equipment and more efficient ways to recover and use all of the combustible material that comes out of the mines is being vigorously pursued. Peak production of coal has probably been reached and any coal inefficiently used or wasted will have to be replaced by imports. Imports will still have to continue, but if the price of American coal increases, greater efforts will be made by the European nations to conserve their own supplies and to find substitutes for coal imports.

Cleaning Plant Design

The design of a modern coal cleaning plant is based primarily upon a washability study of the coal to be cleaned and the specifications outlined by the purchaser. Pilot plant cleaning tests are often made on carload lots of the coal under study to determine how near the mechanical cleaning results can approach results indicated by the washability study. A satisfactory flow sheet must be decided upon after which the size, type, and amount of equipment to be used can be estimated.

When a tentative agreement has been reached as to the kind of cleaning plant that will be required to produce desired results, a careful review of the flow sheet and specifications should be made to see if certain basic features have been included. A modern cleaning plant, especially one in which total cleaning is involved, should meet these qualifications:

(a) Prepare end products with quality and uniformity that will be acceptable in a competitive market whether here or abroad.

(b) Qualify as adhering to the principle of conservation of natural resources by recovering all of the marketable fuel entering the plant as ROM coal.

(c) So designed and planned that it can be operated to show a profit for its owners.

(d) Designed to meet the requirements of existing or anticipated stream and air pollution laws in that area.

Generally speaking the equipment needed to meet the above principles or requirements is available even though some of it may not yet be in general use. Research work along these lines is being done by equipment manufacturers, coal companies, and research organizations. Much attention is being paid to fine coal washing, drying, and centrifuging. Fine coal washers such as the Feldspar jig, which are already in widespread use in Europe,

and a somewhat similar jig being developed here, promise to accelerate the trend to include complete fine coal washing and recovery in the modern cleaning plant. This will be particularly true if this type of washer can be used for low gravity separation, when necessary, to produce a metallurgical grade of fine coal from an otherwise unsuitable product. Fine coal washing and upgrading promises to become an increasingly important part of the cleaning process in future coal preparation plants.

A substantial increase in cleaning plant yield can result from the recovery of extreme fines which have largely been wasted in the past. It has been estimated that 1,000,000 tons of metallurgical fines are lost each year in waste water from cleaning plants. It not only represents a financial loss, but it is a waste of a valuable grade of resource that is being depleted. Recovery of these fines involves dewatering, usually creates drying problems, and may also require additional beneficiation by some cleaning process. However, if it is necessary to remove all fine slimes from washery water in order to release some of it to surface drainage and still conform to stream pollution laws, it may then be economically feasible to add some additional equipment such as froth flotation to clean the slimes, and from them recover a marketable product rather than discard them all as refuse. A noticeable trend toward froth flotation has developed and increased use of this process in the future can be expected.

A number of frothing agents are being successfully used at the present time to recover fine coal from the water. The resulting froth that is formed has a sticky sudsy nature which makes it difficult to dewater. A reagent that will produce a froth without such objectionable characteristics would find ready acceptance. Kerosene or some other such hydrocarbon may prove to be helpful in solving this problem.

In 1934 the Philadelphia and Reading Coal and Iron Co. started research work on flotation cleaning of anthracite fines. This work was carried on by Frank Lasseter under the direction of Dr. H. J. Rose. In 1938 a patent application was filed and in December 1940 a patent on the Lasseter Process of Flotation was granted. This process was put into full scale plant operation on May 1, 1950. The anthracite fines recovered by this method of cleaning are low in ash and moisture content and are loaded directly into railroad cars unless further sizing is required. Natural gravity drainage occurs quickly in the cars after loading. Size of the anthracite treated in this plant is 10 mesh by 200 mesh, and the only reagent used other than kerosene is a minute amount of alcohol frothing agent which is added at the intake end of each train of flotation cells. Kerosene is now being used to a limited extent in froth flotation of bituminous coal, but more research on its application and possibilities should prove to be a sound investment.

Pure Stream Legislation

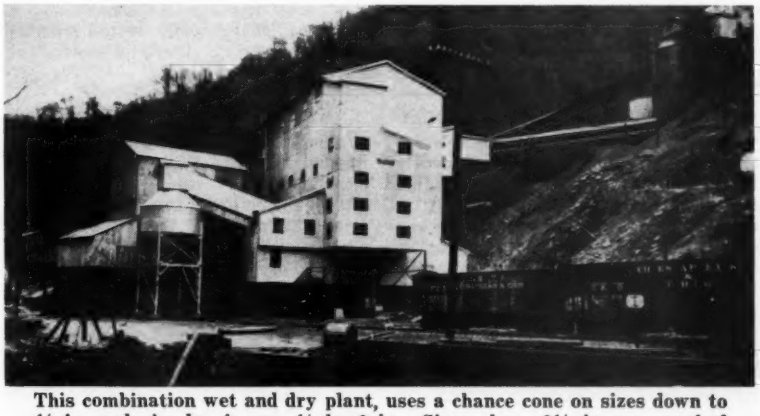
Stream pollution laws are being more rigidly enforced each year, and the trend will likely continue in certain areas. For that reason it is essential, when new wet cleaning plants are designed, that provision be made to clarify any water that may have to be discharged into streams. The water pollution control act administered by the U. S. Public Health Service places control of stream pollution in groups of states which lie within certain drainage basins. As an example, there are eight states included in the Ohio River Basin, and each state has its own pollution laws and interpretation of stream pollution. In some of the states the laws are quite strict and rigidly enforced, while others are still quite liberal, but the tendency is toward more strict enforcement each year. If any practical means of preventing stream pollution in a given area is known, cleaning plant operators will be required to use such means as far as possible, and they should be incorporated in plans for new cleaning plant installations.

The trend in attempting to upgrade practically all coals into premium markets which heretofore they have been unable to enter is causing changes in design of some cleaning units and increased use of others already available. This trend is understandable when it is realized that the price paid for metallurgical coal during the past two years has averaged from $1.00 to $1.20 per ton higher than screenings for industrial uses.

Dense Media Cleaning

Increasing use of dense media separation usually accompanied by separate treatment of the fine coal is one result of this trend. Dense media cleaning of finer coal sizes may become a reality soon in the United States. The Dutch State Mines in Europe have developed a low pressure cyclone washer using the dense media system. Low pressures in the feed reduces wear, requires less power consumption, and simplifies plant layout. Less rinsing water is required for the products, thus reducing the size of the thickener and the magnetic separator for recovering the magnetite. Feed pressure as low as 5.6 psi is possible and yet make excellent separation.

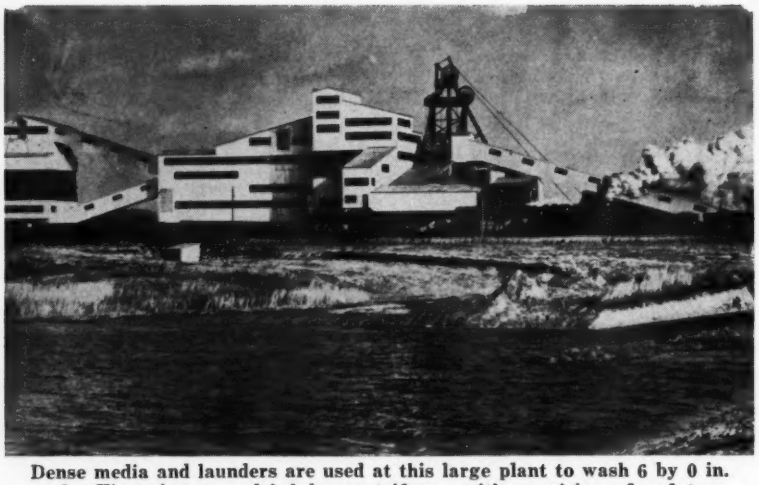
Use of dense media cleaning often results in the recovery of enough extra fuel to justify the extra cost of installing it. Maximum recovery of marketable coal from cleaning plants requires a more complex washing circuit than some of the older plants now have, and may even require the loading of some of the product as a secondary or high ash steam coal if a market for this product is available. Crushing and retreating of middlings for recovery of additional high grade coal can sometimes be successfully done. Unless there is also a market for the lower grade material resulting from this process, however, it may not be economically justifiable to try to recover the maximum amount of highest quality product. If the resulting inferior product has no market or must be sold at a loss, it is a matter of simple mathematics to decide whether or not the two products sold separately will bring more revenue than if sold as one product.



This combination wet and dry plant, uses a chance cone on sizes down to ¼ in. and air cleaning on ¼ by 0 in. Sizes above 2½ in. are crushed before washing

Jigging—Popular Process

Although jigging is one of the oldest processes, it is still the most popular one for cleaning coal and of all the different types of jigs that have been used for this purpose, the Baum type is the most widely used today. There are many modern cleaning plants in which the jig is the only cleaning unit used. The entire ROM product from a certain top size down



Dense media and launders are used at this large plant to wash 6 by 0 in. coal. Fine sizes are dried by centrifuges with provisions for future thermal drying

to 0 is fed to the jig and the entire cleaning is done in one operation. Cleaning of the fine sizes is accomplished by drawing the fine refuse as hutch down through the jig screen plate under the coal bed where it is picked up by the refuse elevators.

In case the jig cannot produce a satisfactory clean coal in the fine sizes, one of two alternate methods is usually used. Either the fines are screened out ahead of the jig and cleaned by other units, or they are wet screened out of the jig clean coal and retreated in other units. The modern trend is to upgrade the fine coal as much as possible to get it into the premium markets, so one of the above alternate methods is usually included in plant design where maximum upgrading of the fine sizes is vitally important.

Dust Collection

Air pollution by cleaning plants is usually caused by the emission of dust from thermal dryer stacks or cyclones or from cyclone-type dust collectors of dry cleaning systems. Control of air pollution generally means additional dust collection facilities to assist existing ones, or if it is a new plant, including in it facilities that have already been proven satisfactory. One large manufacturer and builder of cleaning plants and equipment uses a large diameter silo type low velocity stack into which cyclone collectors or direct exhaust from either fine or coarse coal thermal dryers such as the down draft can exhaust the dust laden air. Occasionally water sprays are installed in the silo to bring the exhaust below the dew point and provide final settling out by condensation. In case of the Flash and Cascade type dryers and occasionally the Pulso, a cylindrical type of wet cyclone scrubber is being successfully used for efficient dust collection. A new type of cylindrical scrubber is now being introduced and is claimed to be giving very satisfactory results. If completely dust free discharge to atmosphere is required, it probably would require the use of fabric filters or some other equally efficient device.

Dry Cleaning of Fine Coal

All of the trends which have been mentioned have a direct bearing on cleaning plant design as they tend to add to the complexity of such designs. It is a happy but rather rare occasion when a plant can be designed to screen out and bypass the fines around the cleaning units. It is also becoming increasingly difficult to use pneumatic separators for cleaning the finer sizes due to the increasing use of water sprays on and around mechanical cutting and loading equipment in the mines. If a washability study shows the fine fraction amenable to pneumatic cleaning or a pilot plant test shows favorable results when the fines are dry, then it becomes a question as to whether it is cheaper to pre-dry the fine sizes the necessary amount and use the dry process for cleaning them, or to put all of the coal through the wet process and then dry it. It seems that use of combination wet and dry plants wherever possible could be of great help in cases where limited water supply, stream pollution laws, and means of water clarification are now, or in new installations will be, major problems. It is quite obvious that if the fine sizes of coal can be cleaned by the pneumatic process there will be no drying problem at the end of the process. If the coal is sold on as received Btu basis, there is little or nothing to be gained by lowering the ash content in the fines if moisture is left in them in place of the ash.

A trend in the opposite direction from those mentioned is the increased tendency to simplify loading schedules. Many special screen sizes formerly thought necessary for sales purposes are being eliminated and as few sizes as possible are being loaded. In many new plants the entire ROM product is put through a breaker or crusher to reduce it to a certain top size before it reaches the cleaning units. After cleaning it may then be assembled for loading as a single size range, or if necessary, loaded in as few sizes as possible. Coal being prepared for power plants or for coke ovens can usually be loaded as one resultant size.

Trends in Processes and Equipment

Some of the features that are already in use to a limited extent or seem destined to become a part of future coal cleaning processes together with some of their advantages or disadvantages may be summarized as follows:

(a) Removal of clay and coal slimes from the water by means of flocculation will see more widespread use in the future, particularly if more efficient flocculents are developed. Treated starch is an effective flocculent for clay slimes, but if used in a plant where froth flotation is also used for fine coal recovery, it will lower the efficiency of the froth flotation process. In the Emma Mine cleaning plant of the Dutch State Mines in Holland, for example, it was found that when treated starches were used as flocculents they were very effective as such and assisted in dewatering the filtered product, but they had a detrimental effect on froth flotation when the clarified water was recirculated. As little as two parts of starch per million has been shown to be detrimental in the circulated water. Substitution of synthetic flocculents for starch proved to be quite satisfactory in their case.

Synthetic flocculents have been developed here which have an efficiency comparable to starch and yet do not interfere with froth flotation to any appreciable extent. Removal of clay slimes by flocculation or possibly by centrifuging ahead of froth flotation is an economical advantage as the suspended fine clay requires excessive use of reagents, due to about 30 percent of the reagent remaining in the filtrate and not being absorbed by either the coal or the clay.

Development of more efficient frothing and flocculating reagents will result in smaller treatment vessels being required, thus reducing capital investment as well as maintenance and operating costs. Froth flotation cones are being used in Europe and may soon find an application here. More research into the use of conditioning and flotation agents for the recovery and upgrading of high and low rank fine coals should prove a profitable investment for the United States coal industry. Addition of chemicals to circulating water for the separation,

drying, and upgrading of the suspended fine coal in the water is a future possibility if proven economically feasible.

(b) A new type of wet sizing screen for fine coal and slimes has recently been put into commercial production in this country. It was first developed and put into successful commercial use on fine coal in the Netherlands. First used here for such products as potash and phosphates, it is now entering the coal cleaning plant market. It is a stationary screen requiring no mechanical vibration or agitation and is essentially vertical when in working position. It is made up of rectangular steel bars two mm in width spaced the right distance apart to give required resultant size, and so mounted as to make the screen surface concave in the direction of flow. Size of openings between bars range from 3.0 mm to 0.75 mm, which gives a resultant range of sizes through the screen from 8 mesh to 48 mesh. The maximum size of material going through the screen is ½ the width of the opening between bars. This screen is non blinding, has a capacity from 10 to 50 times the capacity of other screens handling the same product, and will deliver a resultant product comparable in size to the same feed dried and screened over a vibrating screen of the same size. Units are made in widths from one to 4 ft and have a capacity up to 500 gpm of feed per ft of width. By selecting the correct size of opening between bars, it seems that objectionable clay or slimes could be removed prior to final treatment. This screen is essentially a sizing screen and not a dewatering screen as the end product has an average moisture content of about 25 per cent. However, its potential usefulness is quite obvious, and it seems destined to find its place in fine coal recovery and beneficiation systems.

(c) Thermal drying of wet washed small sizes of coal by complete or partially fluidized bed processes should advance rapidly. More economical drying of fine coal with minimum degradation would have great appeal to the coal producing industry. Simplicity of design and operation with low maintenance cost per ton must be the goal of those attempting to introduce new ideas or new equipment into the thermal drying field.

(d) Ample raw coal storage ahead of the cleaning plant should reflect increasing interest in future design, especially for plants where complete cleaning of all sizes is contemplated and where full seam mining will be used. This is one of the most important yet most neglected features in the history of coal cleaning. Feeding a cleaning plant from storage bins means more efficient cleaning, less starts and stops per shift, more daily capacity for the size of the units due to more uniform feed, more tendency to automatically blend in irregularities in size consist or in ash and sulfur content, and less maintenance due to fewer breakdowns caused by overloads from surges of coal from the mine. Temporary shut downs or lost time periods in the cleaning plant will not affect mine production if sufficient storage space is available to receive the coal coming from the mines during those periods. Continued demand for increased coal production will result in more serious consideration for storage bins in future cleaning plants.

(e) Over 18,000 tph of plant capacity for cleaning or for fine coal recovery were added or contracted for by coal companies in 1956, and indications are that even more capacity will be added or contracted in 1957. Full cleaning of all sizes and recovery of all marketable fines will be a feature of many new designs. The percentage of coal mechanically cleaned has increased every year for the past 30 years and has now passed 60 per cent of the mine output. This trend should continue to rise each year as long as the trend in mechanical mining continues upward. Cleaning of the entire ROM product will follow the trend in mechanical mining.

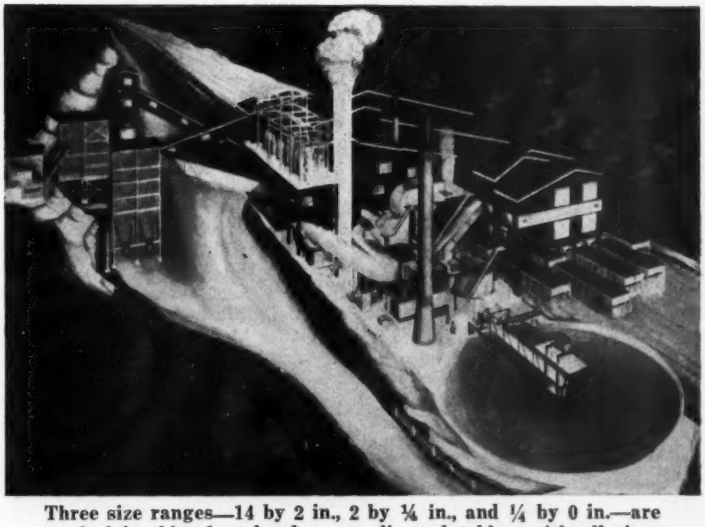
(f) Attempts to upgrade low quality coal into premium grades will continue and as a result, cleaning processes become more complex, more expensive to operate and maintain, and require greater capital investment. If upgrading requires cleaning at low gravity to remove bone coal or middlings, a market for this material must be found, or otherwise the loss in the refuse might more than offset the increased revenue derived from the higher quality coal produced.

Simple cleaning at 1.55 to 1.60 sp gr is ordinarily good enough to produce a good grade of steam coal, but a gravity as low as 1.35 may be required to produce a satisfactory metallurgical product. In that case, if there is a product between those two gravities, it should be recovered as a steam or commercial product if in sufficient quantities to justify saving it.

(g) Progress in the control of air pollution caused by dust from cyclone collectors is being made. New and improved types of scrubbers are available and the use of large diameter stacks with water sprays properly located have proven successful. Reclamation of valuable fine coal otherwise wasted as well as elimination of potential litigation due to air pollution are the two goals in this phase of cleaning plant design.

(h) Manufacturers are constantly in search of new and better cleaning and preparation equipment as well as more efficient ways of using that already available. Coal producers must make every effort to keep the price of coal competitive with that of other fuels. Use of modern mining methods and equipment will help keep mining costs down, and complete recovery of all marketable coal going into the cleaning plant will usually prove profitable. In many cases it is false economy to throw away as refuse a portion of the lower quality coal in order to upgrade the remainder. Extra equipment to make that secondary product marketable is usually a good investment.

Gradual exhaustion of reserves of competitive fuels will result in rising discovery and production costs long before coal supplies begin to be exhausted.



Three size ranges—14 by 2 in., 2 by ¼ in., and ¼ by 0 in.—are washed in this plant by dense media and tables, with all sizes under 2 in. thermally dried. All water borne fine material is thickened and recovered by vacuum filtration

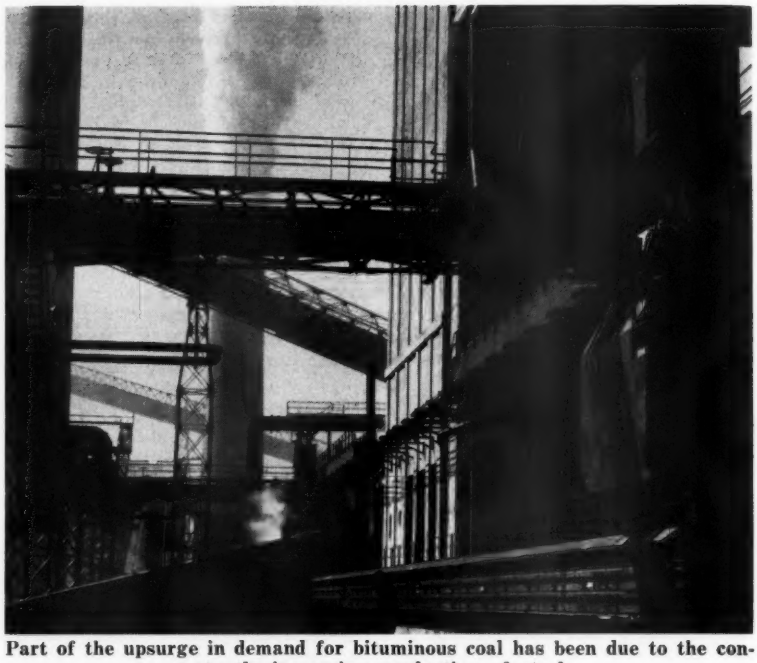
Summary

Increased mechanization of mines and mining of lower quality seams of coal are creating new problems in cleaning plant design. Upgrading of low quality coals requires additional cleaning equipment and new techniques in cleaning plant operation.

Total coal recovery including middlings, near gravity material, and fines will be included in practically all future cleaning plants. Equipment and material for doing so are already available and in use in some plants.

Techniques in flocculation, froth or kerosene flotation, and other means of clarifying water and recovering suspended fine coal will find increasing application in the design of new cleaning plants, especially where the entire ROM product is cleaned by one of the wet processes. Research by manufacturers, coal producers, and research agencies will accelerate the advance of these techniques. A German process known as Convertol is being tested by the U. S. Steel Corp. This process is used to recover fine coal from washery water by using oil as a flotation media. The recovered fines will be added to other sizes of coal being used in their coke ovens. Feasibility of using this process on a commercial basis will be decided when more data has been obtained from the plant in which the steel company has made the installation.

New methods of cleaning, screening, dewatering and drying of fine coal in the approximate size range of 28 mesh by 0 are being developed and will soon be included in plant designs where they are needed.



Part of the upsurge in demand for bituminous coal has been due to the constantly increasing production of steel

ROOF SUPPORT WITH CONTINUOUS MINING

(Continued from page 56)

The bolt is placed in the hole. A tightening wrench is placed on the drill and the roof bolt is tightened under slow feed. The relief valve at slow feed cuts off at 1000 psi which develops a torque on the bolts from 150 to 160 ft-lb.

The complete drilling and tightening operation described above takes an average time of approximately two minutes. The roof bolters under most conditions always work the drills fast feed. Breaking this two minutes down, one might say it takes approximately a minute and a half to drill the hole and the remaining half minute to place the bolt and tighten it. When considering it takes the continuous miner five minutes to sweep the face for one 18-in. cut, there is enough time existing for each roof bolter to place two bolts each or four bolts abreast across the roof if its condition should warrant.

At the Compass Mine no detailed records have been kept as to roof bolting bit costs for the drills on the continuous miner. However, from what material exists the writer would say that the roof drill bit cost would be less than two cents per ton. This figure also includes the labor required to resharpen the bits. Total roof bolting cost would be approximately 35 cents per ton for bolts and 10 cents per ton for labor.

Need for Fast Bolting

In concluding this article we can say that a rapid means of roof bolting is a "must" in continuous loading. One should also have a means of fast bolting so that the method will be flexible enough to meet any needed changes in the bolting pattern. For instance, roof conditions may require a change from an advancing staggered pattern to a square pattern with bolts in line across the working place. With roof conditions at their worst, the combined bolting time of a lateral line of bolts must be sufficiently less than the amount of time required for the miner to make one sweep of the face. If it should take as much or more time to put in a lateral row of bolts as it does to make one cut across the face with the miner, continuous loading will consequently be sacrificed by bolting delays.

At Compass Mine the solution to this need of fast bolting has been solved by the side mounted roof drills. These fast operating drills have helped to minimize bolting delays and have not interrupted the continuous loading. From experience with bad roof, we have found these drills flexible to meet every needed change in our bolting pattern. With poor roof conditions, a need for four bolts laterally spaced across the room results. This is accomplished in four minutes (two roof bolters—two minutes per bolt) which is one minute less than the average time to sweep the 17½ ft wide room.

It would be extremely difficult at this mine to bolt any other way because of the room occupied by the extensible belt trailing the miner. Neither could a pinning machine of any size work along side the miner because, with the present room width at a maximum in this particular locality, there is not sufficient room between the rib line and the miner. One might possibly resort to a smaller pinning machine that would work along side the miner, but again one would probably be limited to the flexibility of such a machine. Difficulty would also be encountered in reaching inconvenient places and the resultant would be a higher bolt cost with the continuous loading being sacrificed by bolting delays.

In final conclusion we can say that continuous loading must be followed by a fast, flexible, and safe means of roof bolting. It should in no way ever interfere with the continuous loading, yet it should be adaptable to all types of varying roof conditions. At Compass Mine, we have found this in two Joy roof drills side mounted on the continuous miner.

Ground Support in Bulk Mining

In summarizing the experiences of several Lake Superior iron range operators in their attempts to resolve heavy ground problems, the author covers methods involving roof bolts, conventional timber, rigid steel supports, yielding steel arches and concrete

By R. W. EDWARDS
Superintendent, Morris Mine
Inland Steel Co.

RISING labor costs have accelerated experimenting in the general problem of bulk mining since it has been absolutely necessary for underground operators to increase the tons per man if they are to remain in business. Block caving with its numerous adaptations—and it's because of these numerous adaptations and deviations from the true block caving principle that the term bulk mining is used — has proven in most cases to be an answer to these rising labor costs. However, the new gains in production were accompanied by new problems.

Causes of "Heavy Ground"

Before discussing these problems, let us consider some of the causes of heavy ground. There are three principal ones: "Ground flow," sometimes referred to as "earth pressure," is present to a more or less degree in all underground openings and is particularly troublesome when the openings are made through soft materials such as dikes, slates, fault gouges or ore. "Ground subsidence," another cause of heavy ground, may be due to the proximity of mining operations or to weakness of the bedding or cleavage planes in certain types of formations because of faulting or lack of adhesion, permitting the material to slip on itself and become unstable when an opening is made in it. The third, "ground swelling" or expansion, is due to the exposure of an excavation to air or water or both.

There are other minor causes of heavy ground such as superficial looseness of the roof or sides, rock bursting or "popping" due to stresses in the rock set up by faulting which usually quiet down after the original "bursts" and cause no further trouble, and perhaps others.

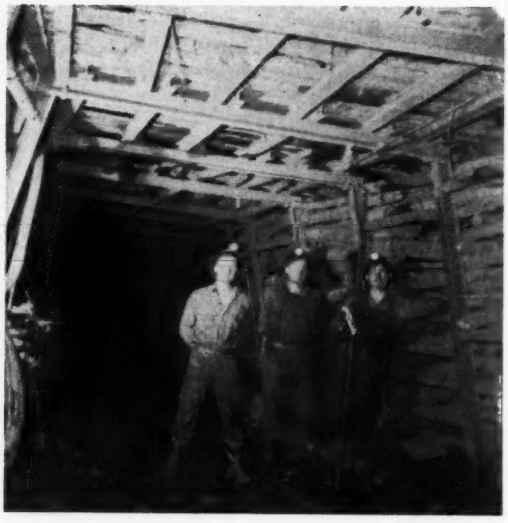
Choosing Type of Support

The above mentioned principal causes of heavy ground—namely: ground flow, subsidence and swelling—are present in most deep mines, but each must be contended with in a somewhat different way. The problem is not how to support, but rather how to cope with, these types of heavy ground so that the supporting members—whether of rigid steel, yielding steel, concrete, or conventional timber —will give the maximum life before replacement is necessary and at the least expense for labor.

There are a good many factors which enter into the choice of the type of support such as: *location*, the distance either horizontally or vertically from the center of disturbance; the *orientation* of the opening, whether it runs perpendicular or parallel to planes of weakness; the *use* to which it is to be put, that is, is it going to be subject to blasting and the impact of scrapers, etc.; the *time* you expect to hold it open; the *shape and size* of the opening; and possibly others.

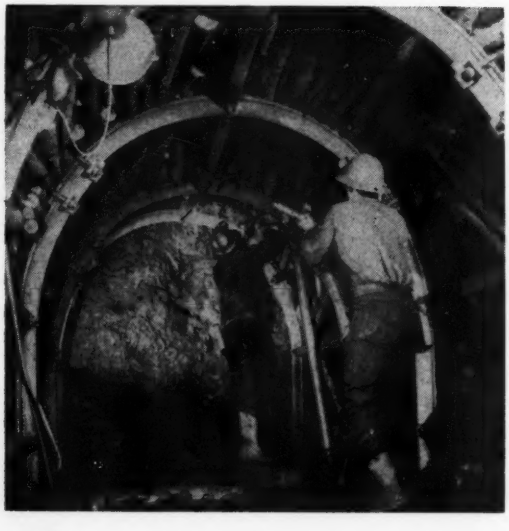
The experiences of some of the operators in the Lake Superior District in trying to resolve their heavy ground problems have been grouped below by type of support used, and the results obtained by each type are described.

Planking the sides of the yielding set permits smooth scraper operation and protects the arch members



A simple four-in. H beam set is used where spalling or rubbly ground is the only weight to be encountered

Rigid arch type sets are used in this scraping transfer. There is a four-in. sill on the bottom which supports the four-in. H beam slide rails



Miners drill for pipe spiling in advance of a new cut in a drift using yielding steel sets

Roof Bolting

Roof bolting is being tried in quite a few properties, particularly in the slate areas. However, it is used only for the spalling type of heavy ground and not where there is ground flow or subsidence. Where used, they have been very successful in holding back the blocky, spalling material. These roof bolts are being used singly and with connecting ties. No set pattern has been established except that the usual spacing is 4 ft centers with more bolts to fit the local conditions.

There are some properties that continue to employ a sub level caving or sub level stoping method where they can use conventional timber sets. The use of treated timber is increasing in prevalence as treating techniques are improved. The choice of using treated or untreated timber depends entirely on the time element for the opening. At one company where they expect the opening to remain longer than six months, treated timber is used.

Because of the difficulty of maintaining the mill or drawpoint in ground where timber sets would be sufficient, some operators have gone to steel sets. The rigid steel sets can be tied together to eliminate their maintenance problem.

With the increasing use of the bulk mining methods and the corresponding decrease in the sub-caving method, the use of timber is rapidly decreasing in favor of the steel sets, both rigid and yielding. In all except a few cases, timber now is employed only in the true sub-caving method.

Concrete Tried

In a further attempt to hold back the ground during these bulk mining operations, concrete has been tried on a large scale basis by one of the companies. Although, this did a better job of supporting the ground than the conventional steel and circular steel sets, this too began to fail, even with heavy reinforcement, under the terrific pressures encountered in bulk mining. The high initial cost of the concrete lined tunnel, combined with the inability to relieve the increasing ground pressures, soon forced the company to search for a better method of support.

Conventional Rigid Steel Sets

Rigid steel sets are actually subdivided into three types: the conventional two legs and a cap, the U shape or arch set having a circular segment cap with straight legs and finally, the full complete circle, commonly called the tunnel liner, all made from I or H section steel.

The conventional sets are used in areas where ground weight is merely caused by the spalling action of the rock and, once the natural arch has been reached, the sets are required to carry only the weight of the broken material. These small liners are usually 4-in. H section steel sets. How-

R. W. EDWARDS graduated from the Michigan College of Mining & Technology in 1939 and went to work for the Bethlehem Steel Co. at its Hanover Quarry. Transferred to the company's Tofo property in Chile, S. A., for 2½ years, he returned to the States

to enter the service. Upon receiving his discharge, Edwards was employed as an engineer by the Inland Steel Co. in 1946. He was promoted to assistant superintendent of Inland's Greenwood Mine in 1948 and superintendent of its Morris Mine in 1950.

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ever, these sets, experience has shown, can not be used where ground pressure is caused by subsidence or ground flow. One company fabricated these sets out of two 8-in. I beams welded together to form a box section on the caps and legs in a subsidence condition with total failure of all sets.

Tunnel Liner Offers Better Support

With repeated failure of these beefed up conventional sets, the full circle tunnel liner set was tried in an attempt to hold back heavy ground under ground flow or subsidence conditions. These sets proved better than the square type or conventional set, but required considerable unloading of the lagging between sets to relieve the ground pressures. One company made progress in overcoming this by using a cushion in the form of a series of very light, short, yieldable sprags interposed between the lagging and the support, so that as the pressures develop these small sprags will fail before the support itself. When this failure occurs, these small sprags, usually made from 8 to 12 in. long pieces of 2 in. diameter cedar, are replaced with shorter ones until the lagging or blocking bears directly against the supporting member. When this occurs, sufficient ground is then removed and the procedure repeated.

This same cushioning effect was noted at another property. In the initial stages of use, the full circle steel set was used. Where there was sufficient lagging between the supporting members and the ground, there was limited deformation of the sets. As the lagging began to deform it was removed, the swelled material removed, and the sets re-lagged. Where sets were placed with little or no lagging between the ground and the supporting members, failures of the supporting members took place within a short period of time.

In one interesting experiment, two parallel scraping drifts, 20 ft apart under a small block cave, were driven 200 ft up a 15° grade along the ore contact. In one of the drifts, the circular steel sets were placed vertical and in the other, the sets were placed normal to the opening. As mining progressed, considerable ground pressure began to develop. However, by taking out lagging, draining off the crushed ore and re-lagging, they managed to mine the block. Six sets were replaced and all six were in the drift where the sets had been placed vertical. The experience here showed that the sets should be placed normal to the opening rather than vertical. The mechanics of placing the steel are easier and the pressure in ground flow are apparently normal to the opening rather than in the vertical plane.

Advantages of U Shape

These full circle steel sets, although they offered better support than the conventional type steel set, decreased the working space and interferred with the scrapers during the scraping operation. The design of the set was changed to an arch type with straight legs which gave a much better working area and a cleaner drift for the scraping operation.

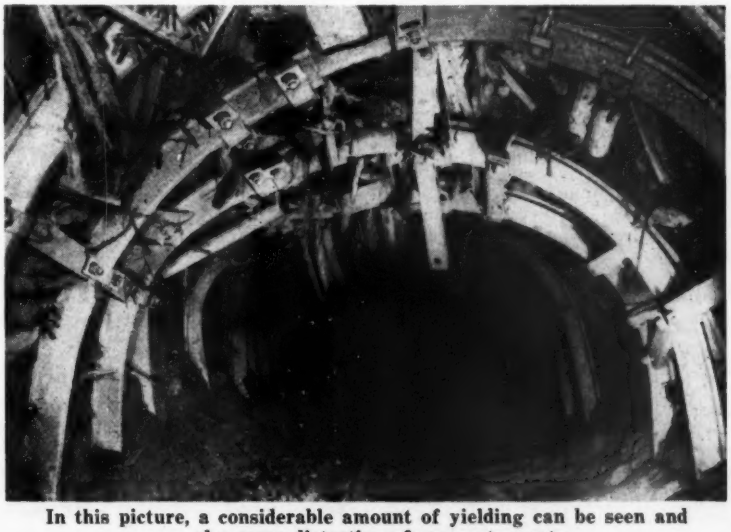
These arch sets are now almost universally a 5-in. 18.5-lb H beam section. In scraping drifts a four-in. H section is bolted or welded to the bottom of the legs to act as a spreader and base as well as a means of fastening the slide rails for the scrapers when the sets are used in scraping drifts. The spacing is usually four ft.

Yielding Type Gives With Load

The yielding or sliding steel support was developed in Germany in the late thirties and early forties as the ground pressure became more severe in her deeper mines. The problem was to develop an economical support that would resist deformation and failure until the natural arch in the rock was formed. A rigid type of support was not the answer as uneven pressures would cause distortion and result in failure. After numerous experiments with different designs and sections, it was concluded that a sliding support had the greatest possibility. This section would yield with the load until the natural arch formed by the rock would aid in the support of the ground above. Also the changes in radii of the curving parts would increase the overlapping and result in increased strength of the support. This type of support also proved very flexible in that it could be used in very small openings as well as very large openings. In ground where the weight is distributed unevenly, this set lent itself very well as more sections could be used and the location of the joints could be placed in the direction of the greater pressures. In real heavy ground, advantage can be taken of this design as the overlapping can be increased, thereby adding strength to the support and increasing the friction to resist sliding.

The initial cost of these yielding sets is slightly higher than the U shaped rigid steel sets, but considering its ease of erection, the total cost of the two types of sets is about the same. The use of this set is spreading rapidly throughout the Lake Superior District for both main haulage and scraper transfer drifts and it appears to be far better than any rigid type

(Continued on page 79)



In this picture, a considerable amount of yielding can be seen and also some distortion of one or two sets

Rehabilitating Large Castings and Forgings

R. L. RECTENWALD
President
Maintenance Engineering Corp.

- Lists such basic methods of inspection as magnetic particle testing, penetrants with whiting, and ultrasonics, noting that a combination of these three methods will usually provide all of the information required to test for fracture and internal flows and to determine the quality of the repair

- Covers in some detail such mechanical joining and welding techniques as Mecostitch repair, heavy bronze welding, and cyclic arc welding

- Discusses location machining and some of the portable machine tools employed

ANYTHING built from man made materials can also be rebuilt or repaired by manual skills and ingenuity. Following this concept, Maintenance Engineering Corp. is dedicated to the development of skills and facilities to effect the restoration of costly and critical industrial equipment which has been rendered useless through accidental wreckage, abuse, or normal wear.

Maintenance of this type must be justified by practical and economical considerations such as savings in replacement cost, savings in production loss, or improvement over original design and construction. Therefore, techniques of welding, mechanical joining of materials and location machining of equipment in the field have been developed in order to minimize disassembly, outage time and replacement costs.

Inspection and Analysis of Causes

The approach of Maintenance Engineering to the repair of any damaged machine is first to determine the cause of failure, if not caused by an accident where the cause is evident. We are always more cautious about making repairs where there is no apparent cause for failure. These unknown causes usually develop from abnormal operating loads, abuse by operators, under design, misalignment, hidden flaws in parent metal, or other things which are often more difficult to locate and correct than making the actual repair. For this reason great emphasis is placed upon refraining from starting repairs until a thorough inspection is made, including an analysis of operating conditions and absolute determination of the cause of failure.

In a search for facilities and inspection tools it is apparent that a combination of three inspection methods will usually provide all of the information required to test for fractures and internal flaws and to determine the quality of the repair. The basic methods of inspection are magnetic particle testing, penetrants with whiting, and ultrasonics. The application of these methods overlap to some degree but all have limitations whereas each can be used to advantage. In general, the magnetic particle method is used only for detection of surface fractures and ultrasonics are used for detection of subsurface fractures and flaws.

On field work the company usually uses the short circuiting method with a welding machine to obtain a magnetic field and often uses iron powder or iron oxide as an indicator. Men are trained in this technique in order to check the quality of welds as the work progresses. The penetrant method is used in confirming questionable magnetic particle test results and the materials are simple ingredients which can be carried in every tool box or purchased in a drugstore.

The inspection discussion should not be terminated without mention of SR-4 resistance strain gages and mechanical strain gages in evaluating operating loads, design strength, alignment, joint efficiency and similar conditions. Due to the complexity of these tests they are usually made where there is some serious doubt about the basic strength and design of major machine elements.

After a complete analysis of the failure has been made and the practical and economic aspects have been satisfied, the most desirable repair procedure is determine by evaluation on the basis of strength, material to be repaired, field location, application of heat, weldability and cost. In the development of a maintenance service business the company has investigated all known methods of mechanical and fusion methods of joining materials. It has been successful in the development of certain mechanical joining techniques and welding techniques which are unique and some are covered by patent applications.

The matter of restoring machined surfaces and alignment must also be considered along with the joining

method. To facilitate the location machine work we have portable boring equipment, turning equipment, planing and milling equipment and internal and external hones. Much of this equipment was designed and built to suit our needs. These machines are built in sections which can be shipped and handled without the use of crane facilities.

Mecostitch Repair

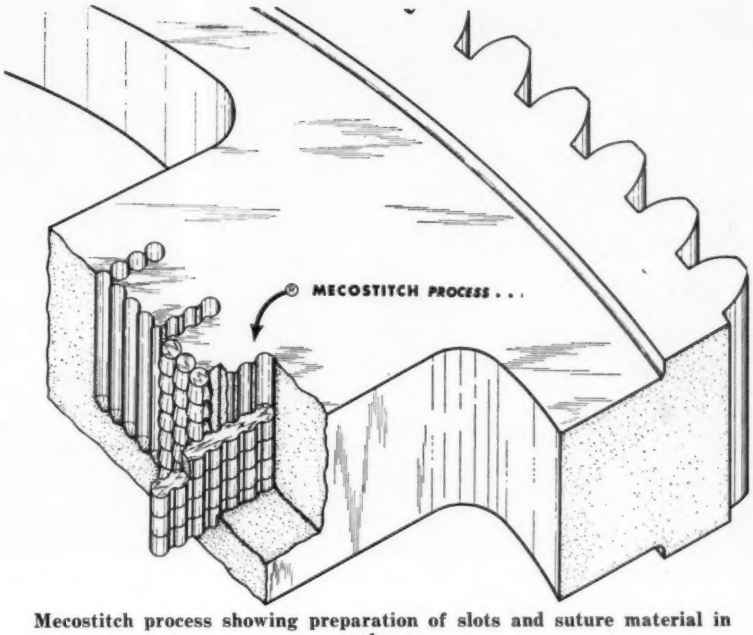
Mecostitch, or mechanical suture, is a cold, mechanical method of joining hard to weld materials such as cast iron and some steel sections where application of heat would be detrimental or hazardous. The basic suture element consists of a square bar of high strength nickel alloy steel which is crimped at regular intervals so that it has the appearance of a number of cylinders joined by straight sections of uniform length.

Sutures are applied by upsetting them into slots of identical size and shape which are cut perpendicular to the fracture. Slots are cut to a depth slightly less than the thickness of the section, and the bottom slot is slightly enlarged to form a dovetail shape. The sutures are then driven into the slots with small riveting hammers and are upset and swelled into the bottom of the slot. Slots are filled by repeating this operation and upsetting each suture individually before the next one is installed.

Sutures are spaced at predetermined intervals along the fracture in such manner that approximately 100 percent joint efficiency is developed in gray cast iron. The spacing of the suture can be about 25 percent closer in steel than in iron but the joint efficiency decreases from 100 percent at about the same rate as ultimate strength in parent metal increases from the 20,000 psi assumed for gray cast iron. In low carbon steel it is possible to obtain between 50 and 60 percent joint efficiency by the Mecostitch method.

After all sutures have been installed, the line of fracture is filled with short dowels or a combination of dowels and studs which are tangent to each other. This material is upset into drilled holes to form a continuous line of caulked metal in the line of fracture. The caulked metal produces a pressure-tight joint, replaces the compressive resistance of the joint and preloads the sutures in tension. This preloading of the sutures is an important feature of the repair because, by this means, fatigue failure through reversals of stress is avoided.

Basic material used in making the Mecostitch suture is a 36 percent nickel steel which has a low coefficient of expansion (about $\frac{1}{10}$ that of mild steel). Other alloys are used where high expansion rates are required. The expansion curve follows a straight line to about 400° F at which temperature the expansion proceeds at about the same rate as iron or steel. This feature is necessary in the repair of equipment operating at elevated temperatures, such as steam cylinders, diesel heads, steam turbines, etc.



Mecostitch process showing preparation of slots and suture material in place

The effect of the dissimilar expansion rates is to preload the repair and cause it to close more tightly until the break temperature of 400° F is reached. Another desirable feature is that while the material is of high strength (80,000 psi annealed) it is also very ductile and can be hammered and cold worked without cracking up to about 130,000 psi ultimate strength in the process of installing the sutures.

Where Mecostitch Works

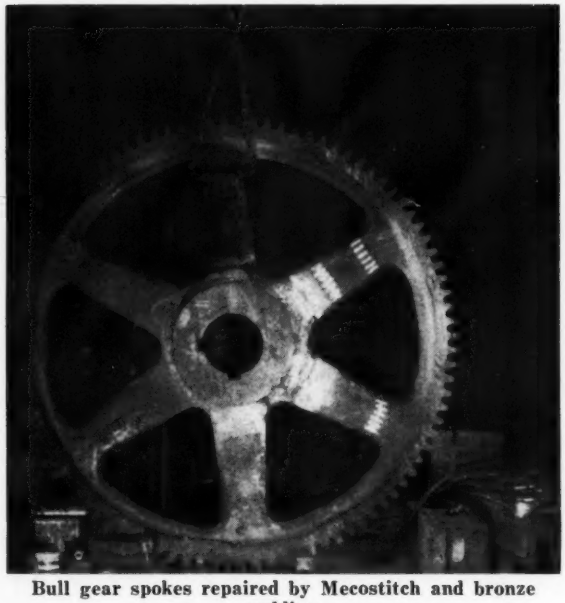
Most ideal application for the Mecostitch method is in the repair of large iron castings which are difficult to weld. The strength of the repair is equal to or greater than any weld and since it is performed cold there is no distortion and often little disassembly required. Repairs on steam cylinders, diesel engines, forging hammer frames, etc. are made without difficulty. Experience also indicates that this method is practical in restoring fractured crankshafts of from 6 to 36 in. in diameter if the fractured section has not progressed beyond 30 percent of the total section and bearings are properly aligned.

Spokes and rims of large flywheels and gears (many over 20 feet in diameter) have been repaired successfully, and this is one of the few repairs of a flywheel approved by insurance underwriters. It is practically impossible to weld the spoke in a large flywheel without introducing harmful shrinkage stresses, warping the wheel out of round and out of balance and often cracking in other areas. In some cases where the break is adjacent to the rim or to the hub the Mecostitch method is difficult to apply. In these cases a line of closely spaced holes is drilled across the center of the spoke, the difficult location is bronze welded and the shrinkage is allowed to break the spoke through the line of holes. The final break is then repaired by Mecostitch without distortion.

Similar combinations of methods are used in many applications where one method is not satisfactory throughout. A related repair method shows a technique of restoring an interference fit in a built-up reversing blooming mill engine crankshaft which weighs approximately 75 tons. This technique covers a method of upsetting small dowels around the periphery of the fit to restore the fit with about ten times the shear resistance of the original keyed joint. Such a repair was completed on location within about 50 hours outage time when there was no replacement available for 12 months.

Heavy Bronze Welding

Bronze welding or brazing is one of the oldest forms of welding but as applied to heavy sections it is fast becoming a lost art. One good reason, from the operators' point of view, is that there are many easier ways of making a living today. In mentioning heavy welds, we are referring to welds of several hundreds pounds to several thousand pounds of bronze deposit. These welds must be preheated by use of portable furnaces and the



Bull gear spokes repaired by Mecostitch and bronze welding

A portable furnace provided for bronze welding large engine frame

weld deposited at a preheat temperature of about 1500° F. Because of the high preheat temperatures, the work is arranged so that a minimum of three welding torches are used at all times with two men per torch. The men work in spells of ten minutes each and relieve each other successively. The work progresses continuously so that a complete section or phase is completed without stopping the work.

In the preparation of the weld all surfaces are chipped clean and smooth and a margin is provided around the weld so that about twice the bond area is available on each side of the weld as the area in cross section. This ratio provides a factor of safety to give a bond strength equivalent to the tensile strength of the weld, which is two to three times the strength of gray cast iron. The furnace is built of about 16 gage sheet steel so that there is about 12 in. of fire bed around the work. Holes are cut in the metal in order to obtain sufficient natural draft to hold a good fire with charcoal and coke. The temperature is regulated to plus or minus 50°F by using asbestos paper as a damping medium to close the draft. As the work proceeds the furnace is cut away to make the work accessible in the work area.

One spectacular bronze welding repair was the repair of a complete wreck of a steam hammer, including frames, cylinder, foundation plates, ram and anvil. A total of about 70 ft of fracture in 4 in. thick cast iron was repaired by a combination of bronze welding and Mecostitch. In this repair 1850 lb of Tobin bronze and three tons of hardwood charcoal were used. The preparation, welding and machine work required three weeks as compared to replacement time of six to nine months. About 50 percent of the total ingot production of the tool steel manufacturing plant concerned was processed by this 16,000 lb steam hammer.

Shock loads and overloads on this equipment demonstrates the strength and impact resistance of both methods of repair in this instance. All areas where pieces were missing, shattered or worn were repaired by bronze welding; fractures which were in relatively flat areas and where edges were perpendicular to the surface with no feather edges were repaired by Mecostitch.

In all of its investigation of welding procedures and materials applicable to repair of cast iron, the company has found no method of joining heavy sections which approach the methods described.

Cyclic Arc Welding

The term "cyclic weld" is a coined expression to describe a technique of arc welding which it is felt is not limited in the mass of weld deposited or thickness of members joined. It can be applied successfully in restrained areas and includes a wide range of weld materials. Experience indicated that this method has replaced the thermit welding method which was formerly used in welding massive sections of steel castings and forgings. Many disadvantages were found in the thermit welding process; however, thermit welding was the only known method applicable for welding of very heavy sections at the time.

The cyclic method is a procedure of arc welding at elevated temperatures as close as practicable to the lower critical temperature of the steel, which is about the lower limit of the plastic phase range in steel or approximately 1000° F. This is, of course, a range between the elastic range and the liquid range of the material. Since it would be difficult and impractical to perform all welding in this temperature range, a compromise must be made with some lower temperature where the operator can be protected from the radiant heat. In general, most of the work is performed between 600° F and 1000° F.

Preparation is accomplished by scarfing and cutting to form a 30° truncated "V" groove, leaving pillars and some original broken edges to support the parts for alignment. The welding begins in the root of the prepared "V" grooves and continues to a point where experience and judgment indicates that the stress relieving phase of the cycle should be executed. This depends somewhat upon the size and shape of the section and the amount of restraint being worked against. In other words, sections where "free end" conditions exist and where shrinkage is not restrained can be welded for several inches of thickness without fracturing. In other sections, where there is very heavy restraint or resistance to deformation by weld shrinkage, the welds may fracture after a few passes. Substantial control over this condition can be exercised by heavy peening to stretch the weld deposit, by proper judgment in the amount of heat and areas preheated and by proper use of restraining members. This knowledge is acquired only through experience and a thorough appreciation of the physical effects of temperature upon the metals involved.

When it is considered that a temperature difference of as little as 300° F

can cause a fracture in some metals and a temperature difference of around 200° F can cause yielding of heavily restrained sections. One begins to appreciate the effects of temperature upon metals and the need for ductility in weld materials. Also, it is important to select weld materials which are not susceptible to imbrittlement and subsequent fracturing in the temperature ranges of the welding operation, stress relieving operation or in the final operating conditions.

Welding proceeds after the exact procedure and sequence is studied and prescribed for each case. At this point it should be emphasized that such erroneous procedures as stress relief by torch or other local heat in a restrained area is detrimental and often is the cause of fracture in an otherwise good weld. After the first phase of weld deposit is completed, the entire section is stress relieved, usually by a portable furnace in such a manner that "free end" conditions are approached. After stress relieving (approximately 1150° F) and inspection by the magnetic particle method, the predetermined preheat is maintained and when the welding continues until the desired thickness of weld is reached again. This procedure is repeated in cycles until the weld is completed and a final stress relief and inspection is made.

It should be apparent that using this method avoids building up of harmful residual stress at any time. Since the shrinkage occurs in the outer fibres of the weld, all internal fibres are in a state of compression and if fractures should occur they can only occur in the outer fibres where they can be seen during inspection. Experience also has proven that where safe welding limits are exceeded and fractures occur, they extend only to the surface stress previously relieved.

Results With the Cyclic Method

Using the cyclic welding procedure, the company has successfully welded steel castings 24 by 48 in. in section with a total weight of about 200 tons. It has also welded forged alloy steel crankshafts over 24 in. diam in alloy steels equivalent to SAE 4140, SAE 6140 and 0.70 carbon steel. Other items included large pinion and roll necks, reversing blooming mill engine spindles, coupling boxes, universal shaft pods and forks, steam hammer rams, steam hammer frames and anvils, massive gear teeth (300 lb per tooth), mill housings, engine frames and many other large expensive and hard to replace parts of industrial equipment. In all of these repairs over a five-year period recurrent failures have been practically nil. Some of the reasons for these excellent results are:

(1) **Critical areas can usually be welded with a sound weld material of high strength replacing a weaker material which often contains an obvious flaw.**
(2) **Large fillets can be formed to replace sharp corners and other stress risers.**
(3) **Areas subject to tension can be prestressed by peening and prestressed in compression to alleviate recurrent failure in tension.**
(4) **Design changes can be incorporated to provide reinforcement where desired.**
(5) **We are assured of complete stress relief which would restore the original stress relieved conditions and would eliminate possibility of other highly fatigued areas which may have developed during the operating history of the equipment.**

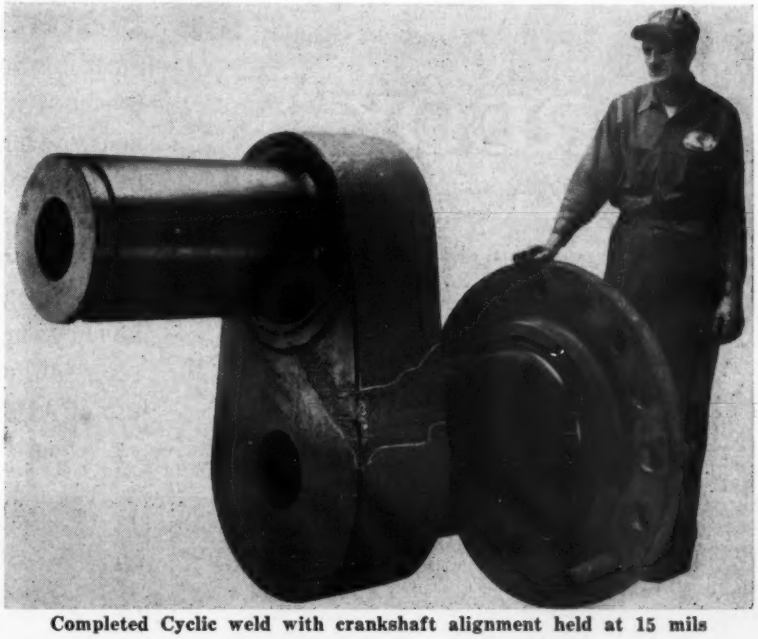
In conclusion, we feel that we have reached a new plateau in the development of metal joining techniques and a wide range of applications lies ahead in the fabrication and repair of heavy welded sections. There seems to be no limit to the mass of metal which can be deposited successfully by the cyclic welding method and the suppliers of weld materials and equipment have developed quite a wide range of excellent products with many more to be introduced in the near future. There is no doubt that development of all-position, semi-automatic welding machines will further reduce the cost of this welding procedure, which even now is less than the cost of the cast thermit weld.

Location Machining

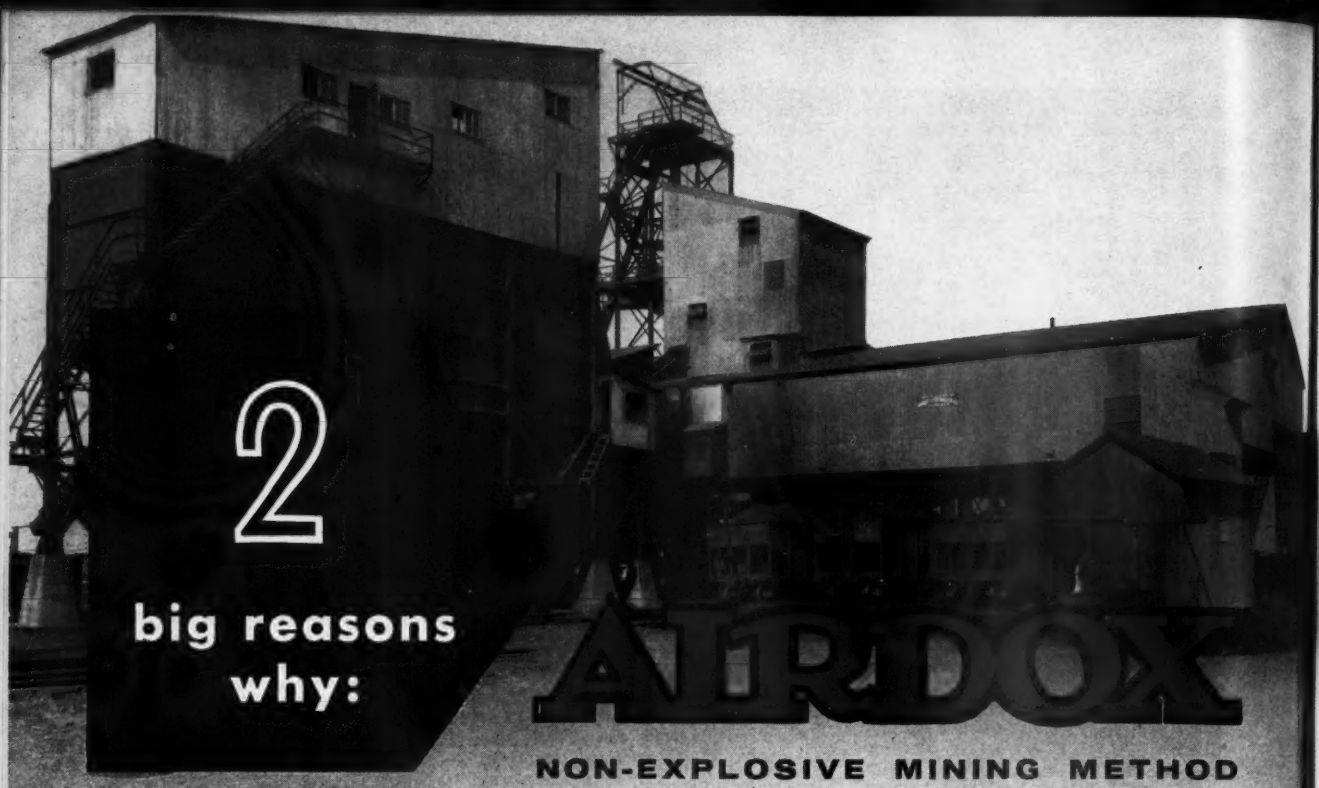
After broken sections are repaired by welding or the mechanical suturing, the next important problem is how to remachine rough or distorted surfaces and restore alignment. To meet this problem, the company has purchased, leased, designed and built portable machine facilities to perform the more common machining operations with which it is often faced. It also has skilled machinists who can hand finish by grinding, filing, and scraping to close tolerances.

The machining rates and cost of these location operations are not competitive with those of production machine tools in the shop, but practically any shop operation such as milling, shaping, boring, turning, planing, burnishing, grinding and honing can be reproduced with portable equipment in the field if the practical and economical factors justify it. With proper tools and experience, commercial tolerance can be held and frequently substantial savings in cost and outage time can be shown as compared with the alternative of dismantling, shipping and shop machining. In some instances the firm has been able to use portable machine tools in the shop at a lower cost than setting up difficult jobs on production tools.

Since there is not a great demand for portable machine tools, development and design in this field is practically stagnant. Also, the skilled and experienced machinist who can improvise fixtures, set up machines to poor references, compromise with field conditions and possesses a high degree of ingenuity is practically nonexistant so that the only means of acquiring such personnel is through a long and tedius training program. Many of the problems facing the location machinist would soon cause frustration in the average mechanic.



Completed Cyclic weld with crankshaft alignment held at 15 mils



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2 Preparation... Deep Vein is primarily a domestic coal and as such must have eye appeal and be able to store with the minimum of degradation — only with the use of AIRDOX is this possible.

HENRY P. SMITH, President
Princeton Mining Company

AIRDOX

NON-EXPLOSIVE MINING METHOD

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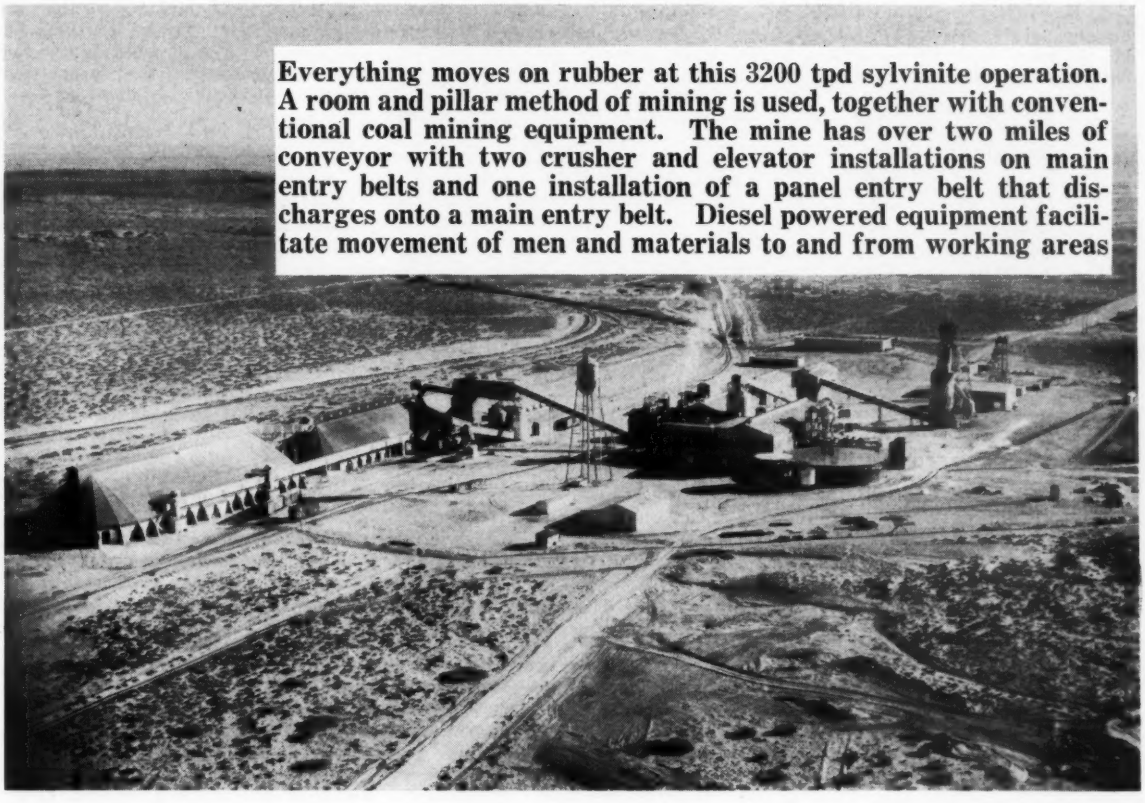


Everything moves on rubber at this 3200 tpd sylvinite operation. A room and pillar method of mining is used, together with conventional coal mining equipment. The mine has over two miles of conveyor with two crusher and elevator installations on main entry belts and one installation of a panel entry belt that discharges onto a main entry belt. Diesel powered equipment facilitate movement of men and materials to and from working areas

Trackless Mining at Duval Sulphur & Potash Co.

By J. E. TONG

Asst. Mgr. & Mine Supt., Duval Sulphur & Potash Co.

SINCE 1952 Duval Sulphur & Potash Co. has used belt haulage in mining 3200 tons per day of the potassium bearing ore, sylvinite. The ore is typical of the Delaware Basin deposits of Carlsbad, N. M., and lies in a horizontal seam averaging eight ft in thickness.

The mining method is the room and pillar system patterned after standard coal mining practice. Conventional coal mining equipment, including loading machines, shuttle cars, cutting machines and auger drills, is used. Some strengthening of equipment is necessary to accommodate the tougher, heavier sylvinite ore which has a specific gravity of 2.1.

Haulage Study Made

The original plan for mining the Duval ore body called for direct shuttle car haulage from the face to the shaft bottom, until the economical limit of such haulage was reached. Soon after leaving the shaft bottom it became apparent that haulage grades would be more severe than indicated by widely scattered core test holes drilled from the surface. With several months of production available by direct shuttle car haulage to the shaft bottom, a study of belt conveyor and rail haulage was made. Information regarding rail haulage in the potash area was readily available. In contrast, only one company had experimented with undergound belt conveyors and little was known of the merits of belt haulage.

This study developed the belief that conveyor haulage would be more economical than rail haulage, provided: (1) that the mine run ore could be crushed to a size satisfactory for belt conveying, (2) that crushing equipment could be readily moved from one location to another, and (3) that sufficient flexibility could be attained to assure uninterrupted production.

Over Two Miles of Conveyor

Complete equipment necessary for 460 ft of conveyor was purchased and installed. This consisted of 460 ft of 30 in. mine type conveyor; 920 ft of 30 in. 4-ply belt with breaker strip, having $\frac{3}{16}$ in. top and $\frac{1}{16}$ in. bottom cover; a 36 by 54 in. single roll crusher mounted on a skid type base, designed to straddle the conveyor discharging directly onto the belt; and a king-size elevating flight conveyor.

This installation proved successful. At the present time the mine has over two miles of conveyor with two crusher and elevator installations on main entry belts and one installation of a panel entry belt that discharges onto a main entry belt.

These conveyors are geared for a belt speed of 500 fpm and move about 550 tons of ore per hour. This tonnage potential was chosen to match the rate of discharge from a shuttle car dumping at the elevating con-

J. E. TONG has been engaged in mining potash ore in the Carlsbad, N. M., area since 1930—working as mucker, miner and mine foreman. In

1950 he became associated with Duval Sulphur & Potash Co. as mine superintendent and was recently made assistant resident manager.

veyor. All main line drive sections are tandem drive, designed to accommodate 75 hp and are equipped with an internal gravity take-up arrangement. At the present time there are 30, 40, 60 and 75-hp motors on the drive units. Intermediate sections 12 ft long are equipped with four-in. rollers. Load idlers are on four ft centers and return idlers are on 12 ft centers. Idler bearings are the pre-lubricated type. All drive pulleys are equipped with self-aligning roller bearings. The longest conveyor now in use is 2150 ft. The average installation is about 1550 ft.

Mining Plan

Main east and west entries extend from the shaft to north-south entries which are 2800 ft apart. The north-south entries will be driven to the limits of the ore body. Panel entries are turned from the main north-south entries at intervals which provide production panels 1100 ft long and 700 ft wide.

The general mining plan calls for the bulk of the tonnage from the northeast section of the mine with only supplementary tonnage from the northwest. After first mining has been completed in the northeast section, the haulage facilities will be transferred to the northwest section, thus affording some savings in capital costs.

Elevating and Crushing Equipment

The occasional large boulder requires the use of a crusher with a high throat capacity to avoid plugging. The 36 by 54 in. single roll crusher meets this requirement and will break 700 tons per hour to minus six in. size. This crusher, when mounted on the skid type pedestals and equipped with a 75-hp motor, weighs approximately 40,000 lb. Skidding this unit intact from one location to another has presented no particular problem even on grades up to ten percent. Moving the unit along our well-compacted roadways is done with comparative ease by using a shuttle car to pull and pushing with a track or rubber-mounted tractor.

The elevating flight conveyor, originally designed with a gooseneck at the upper end, has been straightened to gain elevation at the discharge. The chain speed is such that the shuttle car loses very little time in discharging ten tons of ore. The elevator is of the portable type having retractable rubber-tired wheels.

To date, no damage has been done to a belt conveyor at the feed point; however, there is always the possibility that a piece of tramp drill or bar steel might find its way through the crusher, pierce the belt or do other serious damage. To eliminate this hazard on the longer belts, a run of 56 ft of 30-in. conveyor is used as a feeder to transfer crushed ore from the crusher to the main entry belt.

When the elevating and crushing equipment is located on the main entry conveyor system, it is operated by one man using remote control switches. In addition, this operator co-ordinates the flow of ore to the shaft bottom, relays messages to and from the working area, and acts as the general clean-up man for the area.

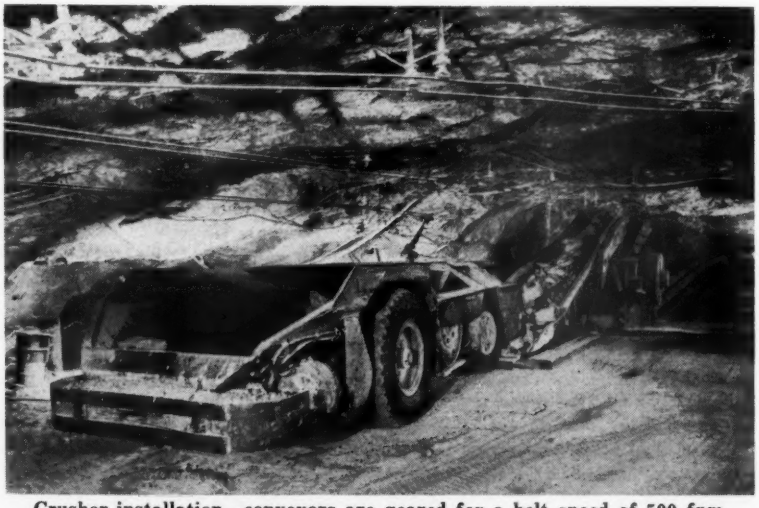
When ½ of a panel nearest to the main entries has been mined, a panel belt is installed. A panel belt installation consists of 650 ft of 30-in. conveyor, a crusher and an elevator. This belt discharges onto the main line conveyor at a point near the main entry crushing station. Remote control pull switches, operated by the shuttle car operators as they approach the elevator, start or stop the equipment. Electrical interlocks prevent starting of the elevator until the crusher and belt are running. All crushers are equipped with underspeed control that stops the elevator if the crusher stops because of shear pin failure.

Operation and Maintenance of Belts

An interlocking control system is used in operating main line belts. Pushing of the starter button at the discharge end of a belt line operates a relay that starts a horn blowing on the first outby belt. After a predetermined warming period controlled by a timing device, a three-step resistance type starter activates the drive motor. This automatic starting cycle follows in proper sequence at each belt along the entire line until the last inby belt is running. In a like manner, interruption of service on any one belt will cause all inby and outby belts to stop. Manual operating switches are located at each belt and used during maintenance and inspection periods. The crusher and elevator controls are also electrically interlocked into this system. An annunciator panel on each belt indicates why a belt stopped, whether it be from overload, underspeed or other reasons. Both operating and control voltage is 440 volts, 3 phase, 60 cycle alternating current.

Motor overload protection is incorporated in the control system. Underspeed switches are located on each head pulley. At each transfer point, a swinging plate equipped with a mercury switch protects against spillage when the chute is blocked. An emergency stop line is installed along the entire belt line.

Maintenance and construction costs have been much less than those estimated in our original study. A daily visual inspection is religiously made while the equipment is operating. Nec-



Crusher installation—conveyors are geared for a belt speed of 500 fpm and move about 550 tph of ore. This tonnage potential was chosen to match the rate of discharge from a shuttle car dumping at the elevating conveyor

essary repairs are made where possible on an off-shift to avoid production delays. Bearing replacements have been low. Belt wear has been especially low. One belt, having moved 2,000,000 tons, shows practically no wear. All belt splices are vulcanized as soon as the initial stretch is complete. Belt life has been substantially increased by carefully engineering the installations, regular and thorough inspections, preventive maintenance and good housekeeping.

Everything Moves on Rubber

Wide entries, good roadways and diesel powered equipment have greatly facilitated the movement of men and materials to and from the working areas. Rapid transportation in highly flexible units from our well-equipped maintenance shop to the production areas has done much to hold down our overall maintenance costs. A truck fully equipped with tools, spare parts and power winch is used on major repair jobs at the working face. A jeep is available for trouble shooting, small repair jobs, and inspections; while a battery powered tractor with complete pneumatic equipment is used to lubricate all mining machinery. A diesel powered flat-bed truck is used in hauling supplies to the working area. Two-wheeled trailers, towed by this truck, haul explosives, timber and other supplies.

Movement of loading machines from one area to another is accomplished by either an electric or diesel-electric shuttle car towing a two-wheeled trailer. Mining machine trucks are towed on long moves by either shuttle cars or tractors. Drilling machines are moved by the same manner. Two-wheeled water trailers are used to sprinkle roadways.

Production workers are hauled to and from production areas in mantrip trailers towed by jeeps. In fact, everything moves on rubber at Duval, a true "trackless mining" operation.

This conveyor installation is on a nine percent grade in favor of load. Belt life has been substantially increased by carefully engineering the installations, regular and thorough inspections, preventive maintenance and good housekeeping

GROUND SUPPORT IN BULK MINING

(Continued from page 71)

of support that has been used to date. The open base of these yieldable arch steel sets, in some cases, is supported by a piece of six-in. channel about one ft long which serves as a footing or, if side pressure begins to develop, the posts are often roof bolted to the walls of the drift near the base. Where these sets are used in slusher drifts, some means of supporting the slide rails must be provided. One method is to lay a four-in. H beam, to which has been welded a ring one in. in height, to receive the end of the leg. This piece doubles as a spreader bar as well as a support for the slide rails. The other method is to lay a 6 ft 4 in. tie five in. thick between the legs to use as a spreader and a support for the scraper transfer rail.

The success of these sets depends on their ability to give with the load, and it is therefore very imperative that they be watched carefully to permit the sliding action to take place. The J bolts must be constantly watched to make sure that they are free enough to permit the sliding action. About once a week they should be checked and rapped sharply with a pick or hammer to start this sliding action. If no movement is apparent, the joints should be checked. These sets are spaced anywhere from two to six ft, depending on the experience in the ground in question balanced against the economics of the closer spacing.

Method Using Ten-Ft Pipe

In the support of heavy ground while driving drifts through dikes, caving or rubbly ground, the following method has been used successfully by at least three companies.

From six to 14 1½-in. holes are drilled over the cap on the last set, into which are inserted ten ft lengths of one-in. pipe. The cut is limited to four ft per cut which is the normal spacing of the steel sets. After each cut, a new set of holes is drilled and pipes are again placed. The result is, after the first cut, a double set of pipe over the back. Although the pipe is ten ft long, experience has shown that only one cut can be blasted on each length of pipe without gambling on the back coming in. One company varied this by drilling 20 ft holes over the back using extension rods in which they placed 1¼-in. solid rods. With this setup, they found they are able to advance three cuts or 12 ft before drilling their second set of 20-ft holes.

With either the rigid or yieldable sets, it is prudent to continue the use of large, heavy timber at the draw points, since these supports will ultimately have to be replaced, regardless of what is used.

Maintenance of Steel Sets

The proper care and maintenance of steel sets, rigid or yieldable, are of the utmost importance. The accepted method of maintaining rigid sets is almost diametrically opposite to the method used with the yieldable sets. In the former, weight relief to prevent distortion can be obtained only by removing and then replacing the back and side poles, lagging and blocking. This must be done as soon as signs of excessive weight appear or the rigid sets will be destroyed. With the use of yieldable steel sets, either arches or complete circles, an almost opposite technique is employed. The openings between the sets should be tightly and uniformly poled and blocked, after which relief from excessive weight is obtained by the yieldable feature. Care should be taken to keep the J bolts uniformly tight and to remove any obstruction which might prevent the joints from yielding. If this is faithfully performed, yieldable supports are almost indestructible.

Heavy Media Separation
For Production of Concrete Aggregates

By

F. F. LEGG, JR.

Assistant Professor of Construction Materials, University of Michigan, and Assistant Supervisor, Michigan State Highway Department Laboratory

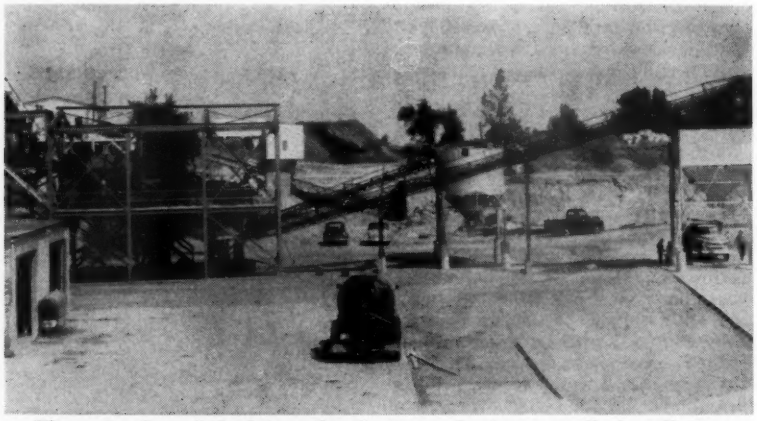


Figure 1. One of the interesting features of a heavy media installation is that the operator can change at will the density of the float liquids to provide aggregate meeting different deleterious content requirements (courtesy of the Killins Gravel Co., Ann Arbor, Mich.)

Concrete consumers in the Michigan area have long recognized the distress of concrete caused by deleterious rock types in coarse aggregate. Laboratory tests have shown that these impurities are predominantly of lower specific gravity than the acceptable material and therefore removable by heavy media processes. Five commercial heavy media plants are operating in the State and proving their ability to compete with producers of imported high quality aggregates for exposed concrete

CLASSICAL specifications for mineral aggregates for portland cement concrete require that the aggregates be "clean, hard, durable particles, free of adherent coatings and organic matter" and usually incorporate similar phraseology. The descriptive word, "inert," frequently occurs in the preamble to more specific requirements. The latter term implies that the role played by the aggregate is, so to speak, to lie dormant in the hardened matrix provided by the chemical union of the cement and mixing water. The aggregates are used, of course, to increase the volume of the mass at low cost and to greatly restrain the volume change of the concrete due to temperature and moisture variations. Present concepts of proportioning the concrete ingredients are to put in the mixture just as much coarse aggregate as can be tolerated, consistent with requirements of workability of the plastic concrete and maintenance of the proper water-cement ratio for strength.

Alkali-Aggregate Reaction

The concrete technologist is now aware, and sometimes painfully so, that the term inert, as applied to aggregates, is often a goal to be achieved rather than a reality. In some regions of the western and southern United States, for instance, certain naturally occurring aggregates have been observed to expand and disrupt the concrete although exposure conditions of the structure are not severe. This has now been traced to a rather elusive chemical-physical reaction between the alkali of the cement and certain forms of silica in the particular aggregate fragments. Much painstaking effort in both the laboratory and the field has been expended over the years to combat this undesirable reaction, and two pretty well-established lines of remedial measures are open: (1) to use a portland cement itself low in alkali content, or (2) to incorporate a suitable pozzolanic admixture in the concrete.

Likewise, in northern climates where concrete may be subject to alternate periods of freezing and thawing in the presence of moisture from rain or snow, much concrete has been defaced on the surface and internally distressed by the presence of a variety of bad aggregate fragments. This action is apparently unrelated to the previously mentioned "alkali - aggregate" reaction.

Improving Paste Constituents

Over the years, progress in improving the weather resistance of concrete in northern climates has been conducted along two lines: (1) Improving the paste constituent, i.e., the binder provided by the cement and water, and (2) the aggregates. Many aspects of the paste constituent have been studied, such as chemical composition of the cement, fineness of grinding, curing and so on. It is now well recognized that overwhelming importance, overshadowing all other variables of a normally acceptable cement, must be given to incorporation in the paste of a small amount of air con-

sisting of a well-distributed system of discrete microscopic size air bubbles. Air-entrained concrete has now firmly established itself where maximum weather resistance is desired, and its development is frequently referred to as the most important step forward in concrete technology since formulation of the water-cement ratio law of strength in about 1918. However, air entrainment does not solve the problem of poor coarse aggregates.

Problem of Poor Aggregates

Until recently, improvements in the concrete aggregate field, on the other hand, have not been outstanding. It was first necessary to devise suitable means for laboratory evaluation of the weather resistance of the aggregate so as to better predict field behavior. Trial and error experience in the field has built up a background of knowledge regarding those types of particles which are definitely unsuitable, such as unsound cherts, iron claystones, and numerous structurally weak mineralogical types.

Recognition should certainly be made of efforts of aggregate producers to improve their products. Quarry operations, for instance, have been devised in some cases so as to prevent undesirable rock from certain ledges from entering the final product. Natural aggregate producers have also had limited success with various types of "soft stone eliminators," usually embodying in one way or another a combination of simultaneously washing and abrading the product. The abrasive action may result from scrubbing by the harder constituents of the aggregate itself, or an artificial abrasive charge may be introduced to break down the softer fragments.

Since not all of the deleterious types of fragments are soft and therefore amenable to removal by abrasive action, it has been general practice, at least in the Michigan area, to simply avoid those deposits which material surveys indicate contain substantial percentage of undesirable particles. This generally resulted in increased cost to the consumer due to increased transportation charges.

This era in our history, that is of avoiding trouble spots, now appears to be rapidly drawing to a close. Ever-increasing use of concrete, well illustrated by the current rapid expansion of cement production facilities, is making greater demands upon aggregate production, and means are now at hand by which some gravel deposits, heretofore considered unsuitable, can be made to yield a high quality aggregate at a reasonable cost and thus help meet this added demand. Instead of being forced to relax the specification requirements to achieve the job at a reasonable cost using local materials, the designer and specification engineer can look forward, in some cases, to the happy day when they may impose more stringent requirements with a view of getting a better job and still impose no undue hardship on either producer or consumer.

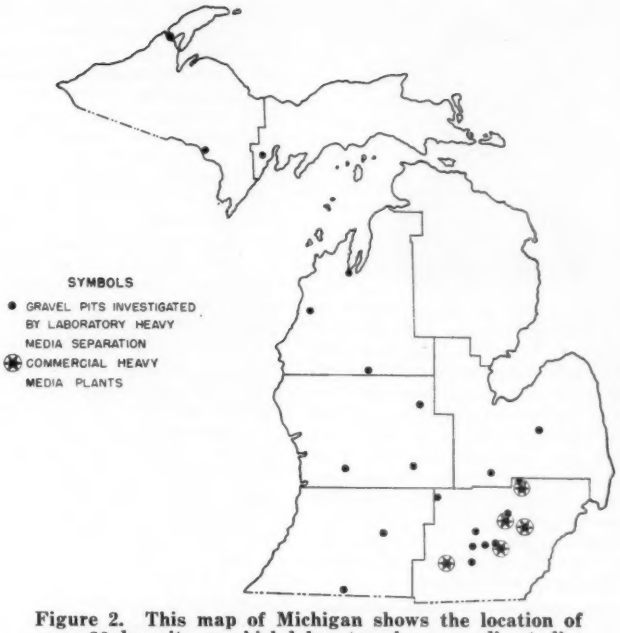


Figure 2. This map of Michigan shows the location of some 26 deposits on which laboratory heavy media studies have been made. Locations of five commercial heavy media plants are also shown. It is significant to observe that these commercial installations surround the highly populated Detroit area in the southeast corner of the State

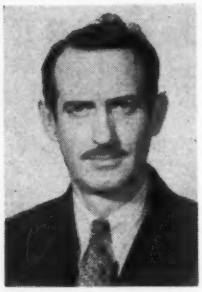
Heavy Media Process Tried

The interest of the Michigan State Highway Department in the heavy media process, wherein the light weight gravel particles are floated off and discarded by use of a heavy liquid made with water suspensions of finely divided iron compounds, became aroused by various favorable reports in the literature. This was supplemented by personal contact with some of the work that was being done at the Joint Highway Research Project, Purdue University, and a laboratory study was consequently initiated and carried on during 1952-53 to determine the susceptibility of Michigan deposits to heavy media treatment.

The laboratory media separation tests were conducted using mixtures of carbon tetrachloride and acetylene tetrabromide in such proportions as to provide liquids of three specific gravities; namely, 2.40, 2.50 and 2.60. These tests showed conclusively that for the gravels studied, every one would be benefited by heavy media separation, and the extent of the benefit generally increased as higher specific gravity solutions were used. In some cases, however, choice of the highest gravity (2.60) would provide a premium product at the expense of loss of as much as 20 percent of what is now regarded as satisfactory aggregate. There appeared to be some optimum gravity, intermediate between 2.40 and 2.60, where an acceptable balance between wastage of good product and a satisfactorily low deleterious content could be provided, and this value would be unique for each deposit. Better acquaintance with commercial plants since these early studies leads to the observation that the commercial plant may be required to operate at a gravity about 0.05 higher than the laboratory studies would indicate since the ideal separation realized in the laboratory is not there obtained. Commercial plants now in Michigan are providing a high quality product with operating gravities ranging between 2.50 and 2.65.

Results of Laboratory Studies

Figure 3 illustrates the distribution of deleterious particles in the four specific gravity ranges for five of the pits on which laboratory studies were made. These particular pits were selected for presentation to show the variations in behavior. The best quality material is invariably contained in the fraction of the sample having gravities greater than 2.60. However, an entirely acceptable product is provided in many cases by using some of the lower gravity fractions. Note that the deleterious material in Pit 1 is predominantly chert which would be effectively removed by discarding the two lower gravity fractions, i.e., by operating at a gravity of 2.50. In the case of Pit 2, this particular material was a product crushed almost entirely from oversize and needed no media



After obtaining an M. S. degree in Physics in 1933 from the University of Michigan, F. E. LEGG, JR., was successively laboratory technician and office engineer for the Michigan State Highway Laboratory. From 1942 to 1946 he served in the U. S. Navy but rejoined the highway department in 1946 in field and laboratory studies on concrete. Since 1949 Legg has divided his time between teaching at the University of Michigan and serving as assistant supervisor of the Michigan State Highway Laboratory.

processing to make it acceptable. Subsequent freeze-thaw laboratory studies on concrete containing this aggregate demonstrated that it was of high quality. The deleterious material in Fit 3 is predominantly soft nondurable particles (ochre, shale, etc.) which are not entirely removed even at a gravity of 2.60. However, the next lower gravity fraction contains very little poor material and this could well be included in the final product. Pits 4 and 5 show no striking variations from the usual pattern—the premium material is contained in the fraction heavier than 2.60 but inclusion of the 2.50 to 2.60 fraction would not be particularly harmful.

The three classes of deleterious particles shown in Figure 3 are those designated by the Michigan State Highway Department Standard Specifications, namely; (1) soft particles which include "shale, soft sandstone, ochre, coal, iron bearing clay, weathered schist, shells, floaters, partially disintegrated particles, cemented gravel and any other particles which are structurally weak or fail to meet the soundness test," (2) chert in which accepted lithological classification is used and (3) hard absorbent particles which include a variety of less easily defined particles which experience over the years has proven deleterious. The concrete technologist working in a given area is compelled to acquaint himself with the types of deleterious aggregate particles which he there encounters. The types enumerated by the Michigan specifications are those which many years of experience have proven troublesome. Generally, they have been identified by probing at the bottom of fresh pits and spalls in concrete surfaces where the remains of the offending particle can be examined. Outside the Great Lakes area, the classifications given may well be inappropriate due both to differences in severity of exposure of the concrete and to structural differences in the rock types even though having the same mineralogical name.

Five Plants Established

The Highway Department has made the results of these laboratory studies available to gravel producers who are interested, and this has unquestionably helped lead to the establishment of the five plants now in the State. The prudent operator would certainly make more exhaustive studies of his own product before setting up a heavy media plant, but the pattern in Michigan seems to be that the deleterious particles are predominantly of lower specific gravity and, therefore, capable of improvement by the heavy media process.

Economic forces of competition have certainly played a part in establishing the five commercial plants cited. Several large consumers of concrete, including the Highway Department, have for some time despaired of getting a satisfactory job with exposed architectural concrete unless the total deleterious content in the aggregate is less than three percent. This requirement, heretofore, could rarely be met by gravel producers in the area and meant that the consumer must pay a premium for importing acceptable crushed limestone generally brought down by water transportation from the upper Great Lakes region and subsequently trucked to the job from the dock. In some cases, acceptable limestone has been imported from northern Ohio or Indiana. Some of the heavy media gravel plants are now proving their ability to market a product meeting this demand for high quality aggregates. Apparently the cost of media processing is less than the cost of importing acceptable aggregates. The very existence of the plants seems to indicate that they are feasible cost-wise.

Figure 4 illustrates the deleterious content of the output of one commercial plant when processing gravel aggregate satisfactory for use in architectural concrete subject to severe frost action. The bar chart covers careful laboratory determinations of 12 samples taken over a ten day period. The "before processing" deleterious particles content is typical for this deposit and is a grand average over a large number of samples. The marked reduction in deleterious particles in the commercial product provided by the heavy media plant is evident.

Freeze-Thaw Tests Favorable

The commercially produced heavy media gravel has not been used in Michigan sufficiently long to establish reliably its field service behavior. However, laboratory freeze-thaw tests have been conducted which lead to a prediction of excellent service performance and furnish a line of favorable evidence completely independent of observation of reduction in deleterious particles content. In this work, the aggregates both before and after commercial media processing were carefully screened to size and then incorporated in 5½ sack air-entrained concrete. The aggregates were vacuum saturated to make them more vulnerable to frost attack. The cured concrete beams containing the aggregate under test were then subjected to alternate freezing and thawing cycles in accordance with A.S.T.M. Designation Method C291 (Resistance of

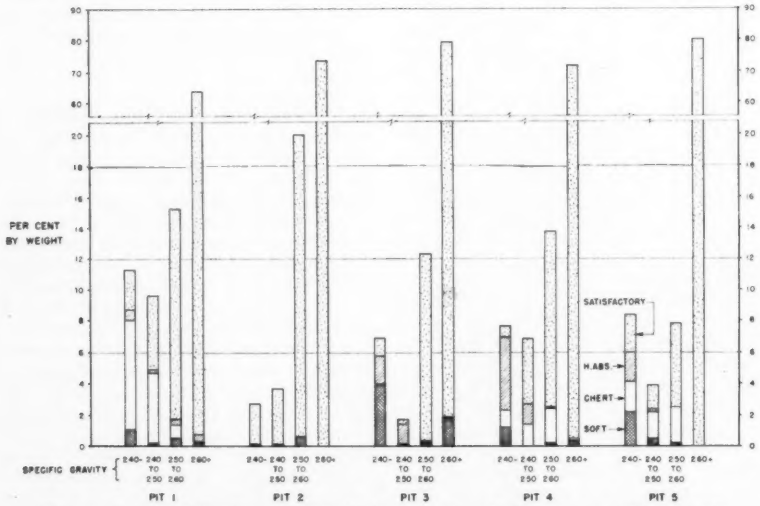


Figure 3. Distribution of deleterious and satisfactory particles with respect to specific gravity for five selected deposits on which laboratory studies were made

Concrete Specimens to Rapid Freezing in Air and Thawing in Water). Failure of the concrete containing the test aggregates is measured by reduction in dynamic Young's modulus of elasticity using A.S.T.M. Designation Method C215 (Fundamental Transverse, Longitudinal, and Torsional Frequencies of Concrete Specimens). This method measures the internal disruption of the concrete due to volume change of the bad aggregate fragments after repeated freezing and thawing and involves no personal judgment as does hand picking aggregate samples for deleterious particles content. The data from the freeze-thaw tests may therefore be regarded as even more convincing of the benefit provided by the media processing. Some results of this work are summarized in Table 1.

	Freeze-Thaw Durability Factor*	
	Before Media Processing	After Media Processing
Plant No. 1	47	83
Plant No. 2	..	91
Plant No. 3	41	87

*** D. F. based on 300 cycles F & T. Thirty percent reduction in modulus considered failure.**

Table 1. Freeze-Thaw Durability of Concrete Containing Gravel Before and After Commercial Heavy Media Processing.

The unprocessed material from Plant No. 2 contained so much deleterious material that it was considered a loss of effort to conduct the lengthy freeze-thaw tests on this very poor material. The durability factors for the other two plants exhibit a marked improvement in durability after media processing.

It is interesting to speculate from the results of the freeze-thaw work as to whether the media processing may actually be floating off and discarding certain light weight particles heretofore unsuspected as being deleterious. In this regard, the media processed gravel from one of the plants was deliberately diluted in the laboratory with ten percent chert of each of four different specific gravity ranges. Table 2 summarizes the freeze-thaw durability of concrete containing this gravel so adulterated.

Media Processed Gravel plus 10% Chert Having Gravity of:	Freeze-Thaw Durability Factor*
(Undiluted)	83
2.60 plus	64
2.50 to 2.55	43
2.45 to 2.50	24
—2.45	16

*** D.F. based on 300 cycles F & T. Thirty percent reduction in modulus considered failure.**

Table 2. Freeze-Thaw Durability of Concrete Made with Gravel Adulterated with ten percent Chert of Four Different Gravities.

The media processed gravel without adulteration had a durability factor of 83 so that the tabulation indicates all the chert, regardless of gravity, to be somewhat detrimental, but the lowest gravity chert is far more so and successively higher gravity cherts are less detrimental. This is a striking example of where assignment of mineralogical name alone, is insufficient to adequately describe behavior in concrete. Possibly other rock types react in the same way with respect to their gravity-freeze-thaw durability relationships. It should be emphasized that specific gravity of a rock type, alone, is probably not fundamental to its freeze-thaw resistance, but rather this resistance is dependent upon its pore structure and exposure conditions. However, if the undesirable pore structure is accompanied by lower specific gravity than the acceptable material, then heavy media beneficiation will surely succeed.

A Typical Installation

The five heavy media plants now in Michigan range from 100 to 300 tons per hour nominal capacity and are quite similar in their operation but have minor modifications. Generally, the plants consist of the following:

(1) Belt or vibratory screen feeding washed and graded gravel to the drum separator.
(2) Drum separator containing finely ground magnetite and water, or for higher gravities, some ferrosilicon may be added. The stones of gravity lower than the solution float out the lip of the drum, and the high gravity pebbles sink and are carried to the top of the drum by paddles and are then discharged. The drum rotates about two rpm.
(3) Vibratory screen where both the low gravity reject material and high gravity acceptable material then separately are washed free of adhering finely ground media.
(4) Drum type magnetic separator for recovering media.
(5) Screw type densifier for concentrating recovered media.
(6) Demagnetizing coil for reducing tendency of magnetized media to floculate.
(7) Storage capacity for discarded and accepted gravel. In the case of the plant shown, at the beginning of the article, the accepted material is stored in the square bin and discard material is conveyed to the circular bin.

It would be highly presumptuous to predict that all gravels could be improved by the heavy media process. Rather simple laboratory techniques are available to study the potential improvement of gravel by media processing, and such tests should certainly be performed before consideration be made to install a commercial plant. Some deposits may have gravels of such specific gravity characteristics that, simultaneously with removal of the poor material, such a loss of acceptable material may be experienced as to make the operation uneconomical.

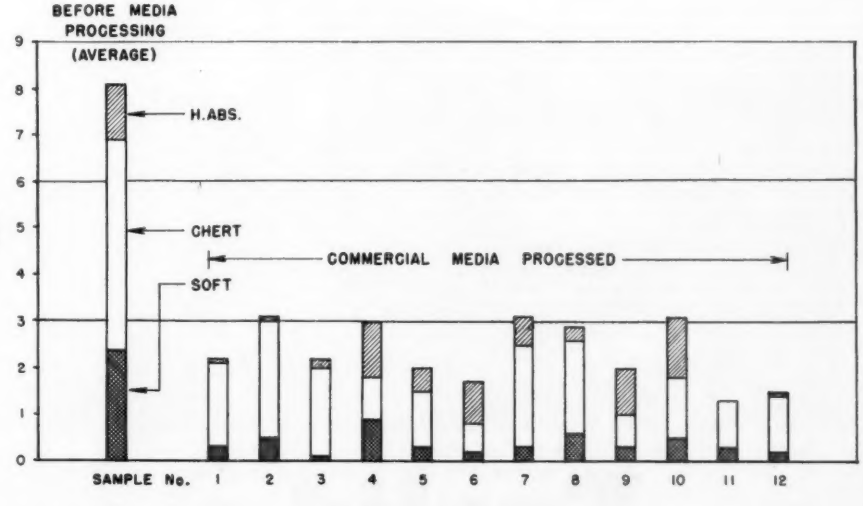


Figure 4. Characteristics of output of one commercial heavy media plant making high quality aggregate for exposed concrete

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1957 AMC Coal Convention And Exposition

During the four days May 13 to 16, some 14,000 mining men converged on Cleveland from all over the world for the fabulous 1957 Coal Show of the American Mining Congress. Over 250 manufacturers from 26 states and from abroad outdid themselves in presenting the most impressive array of mining machinery and supplies ever assembled. Many exhibits featured full-sized machines in operation—some of them being revealed for the first time. Occupying nearly 20 percent more space than the exposition two years ago, the record breaking 1957 Coal Show reflected the optimism and basic strength of the industry.

The thousands of coal miners who attended were able to study at first hand the latest and most efficient methods and equipment for producing the fuel that is so vital to the Nation's progress. With the theme "Coal Builds a Better America," the 1957 Convention and Exposition featured every conceivable type of equipment that plays such an important part in the efficiency of the modern coal mine. Keen interest in the exhibits was also shown by the many metal mining men and industrial minerals producers who attended. They have found that most of the equipment on display has direct application to their problems as well as to coal's.

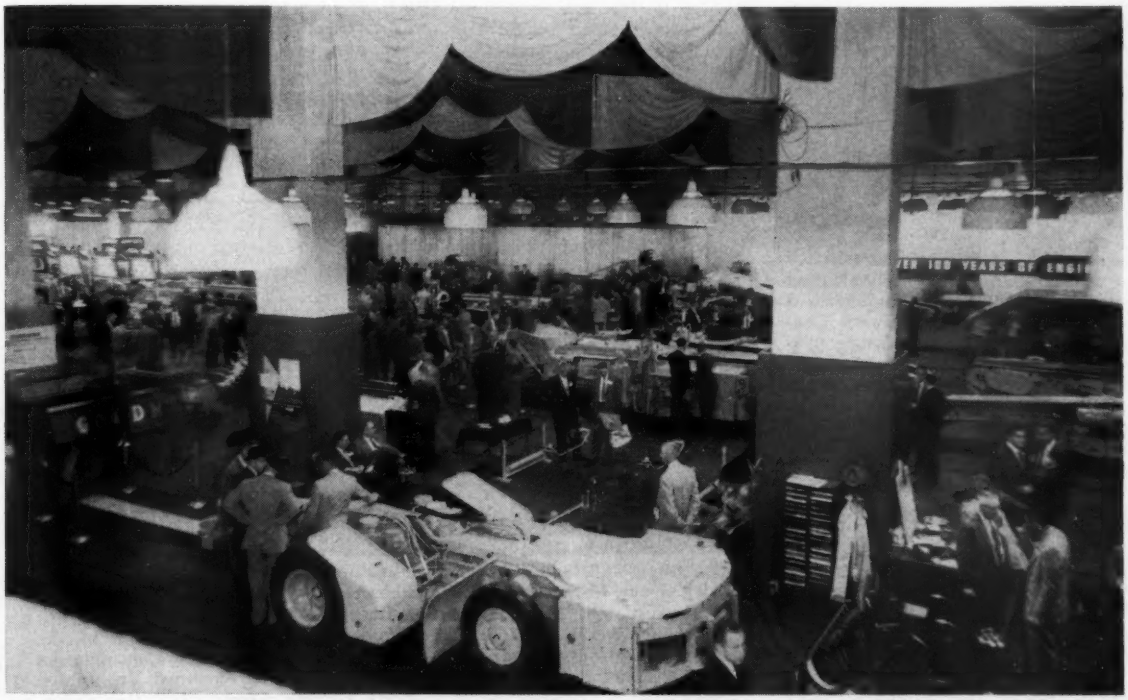
Attendance at the technical sessions was particularly good as top caliber speakers reported on latest advances in deep and strip mining as well as coal preparation and the problems of management and safety. The interest shown in all eleven sessions was a credit to the careful planning of the Program Committee under the leadership of A. R. Matthews, president, Pittsburgh Consolidation Coal Co. An innovation this year was the successful Conference on Industrial Minerals, which covered technical subjects and operating problems of particular appeal to men in the fields of cement, limestone, phosphates, salt, aggregates and others.

Manufacturers Division Meets

No sessions were planned for Monday afternoon so that full attention might be given to inspection of the huge machinery exhibition that covered over three acres of exhibit space.

At the Manufacturers Division meeting that afternoon, Chairman J. E. M. Wilson, Vice President, Jeffrey Manfacturing Co., presided. Julian Conover, AMC Executive Vice President, reported on the activities of the organization during the past year and briefly reviewed the legislative situation in Washington as it affects the mining industry and manufacturers of mining equipment. He also presented a "fill-in" on last year's Mining Show in Los Angeles and outlined plans for the western Convention in Salt Lake City, September 9-12. Next Year's Coal Convention will be in Cincinnati, the week of May 5.

Howard I. Young, President of the American Mining Congress and President of the American Zinc, Lead & Smelting Co., congratulated exhibitors



The 1957 Coal Show was the largest ever staged, with over 250 manufacturers exhibiting every type of machinery and equipment to produce, transport and prepare coal

on the fine group of exhibits, noting the advances in their equipment that are apparent from year to year.

Members elected or reelected to the Division's Board of Governors are: L. E. McDonald, Bucyrus-Erie Co.; K. M. Patterson, Westinghouse Electric Corp.; M. D. Millard, American Steel & Wire Division, United States Steel Corp.; Austin Goodyear, Hewitt-Robins; R. K. Gottshall, Atlas Powder Co.; M. L. McCormack, Ingersoll-Rand Co.; Edward T. McNally, McNally - Pittsburg Manufacturing Corp.; W. D. Moreman, Sanford-Day Iron Works, Inc.; C. B. Peck, Anaconda Wire & Cable Co.; Fred O. See, Cardox Corp.; and Albert E. Seep, Mine & Smelter Supply Co.

At the Board of Governors meeting which immediately followed, the following officers were elected for the calendar year 1958: Chairman, Jack H. How, Western Machinery Co.; First Vice Chairman, W. L. Wearly, Joy Manufacturing Co.; Second Vice Chairman, A. E. Seep, Mine and Smelter Supply Co.; Third Vice Chairman, D. E. Davidson, Link Belt Co.

Opening Session

The first session of the Convention got under way Monday morning with A. R. Matthews, president of Pittsburgh Consolidation Coal Co., and National Program Committee Chairman, presiding.

Howard I. Young, president of American Zinc, Lead and Smelting Co. and of the American Mining Congress, extended a welcome from the AMC Board of Directors to all who were in attendance at the Coal Show. He said the Mining Congress is proud of the part it has played in the continuing advance of the American coal industry, which is envied by the entire world for its productive ability.

Following Mr. Young's remarks, Glenn B. Southward, mechanization engineer with the American Mining Congress for the past 30 years, announced his planned retirement at the end of 1957. He briefly summarized the advances in mine mechanization during the past 30 years, and stressed the important part the Mining Congress has played in stimulating progress in mining practices and in the development of new and improved equipment to achieve greater efficiency and safety, increased production, better recovery and a high quality product.

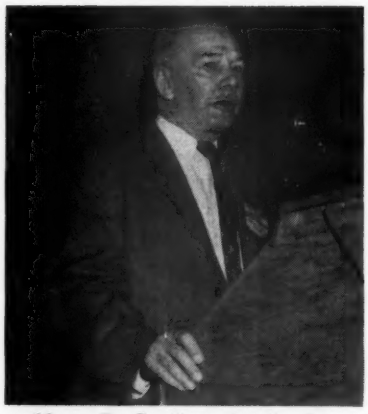
At the conclusion of his remarks, Mr. Southward was given a rising ovation as a vote of thanks for his contribution to the advancement of the art of coal mining.

Continuous Mining Is Growing Up

The first technical paper of the session and of the convention was given by J. A. Sherrard, Jr., chief engineer, Johnstown Coal & Coke Co., whose paper was entitled "Maintenance of Continuous Mining Equipment." Johnstown Coal & Coke is operating six boring-type continuous mining machines in two seams. Coal in one seam is extremely soft and friable with mining rates being as high as 33 in. per minute. Penetration is considerably less in local areas when bottom must be cut with the machine during the mining operation. Coal in the other seam is not as soft and contains, in areas, up to eight in. of hard sandstone middle band. The company strongly feels that "a continuous mining maintenance system must begin in the minds of the design engineer of the manufacturing companies" and "field-proven failure of assemblies must be given immediate design and production priority for revision and for incorporation in existing operating units." The coal company is just now instigating its organized maintenance plan which has been made to provide a unified effort of standard operation. The two most significant changes in historic maintenance methods at the company are the appointment of a maintenance superintendent to make and administer maintenance policy and controls, and the creation of mechanic foreman positions and duties. Training, preventive maintenance, and cost control will be stressed.

The next paper, "Design of a Power Installation for Continuous Operation," was prepared jointly by W. C. Wright, superintendent of maintenance of the Kaiser Steel Corp. and R. T. Blakely, General Electric Co. The paper was presented by Blakely with Wright answering the questions which followed the paper.

Kaiser Steel is operating ten conventional and nine continuous mining units to produce approximately 7500 tons of coal per day.



Glenn B. Southward, who has been with the American Mining Congress for some 30 years, announced that he is retiring at the end of 1957

Eight of the continuous units are a-c powered, the other being d-c powered. Power is purchased from the Utah Power Light Co. at 44,000 volts and introduced into a central metering station. From the metering station power is distributed to three substations, one for each mine, where it is transformed from 44,000 to 4160 volts, the primary distributuion voltage in the mines. The total transformer capacity of the three mines is 9350 KVA. The 4160 voltage is transmitted into each mine through 4/0 rubber-covered primary cable and is transformed to the utilization voltage of 480 volts by a 200-KVA portable mine load substation located in the immediate face area. At the present time each continuous mining unit is fed directly from the mine load center substation without use of an intermediate junction box. All face equipment is pro-

On stage at Monday morning's opening session were, left to right, Alex Grant, Buckeye Coal Co. and chairman of the floor committee; G. B. Southward and Julian Conover, American Mining Congress; Howard I. Young, American Zinc, Lead & Smelting Co. and president of the American Mining Congress; A. R. Matthews, Pittsburgh Consolidation Coal Co. and Program Committe chairman; J. H. Sherrard, Jr., Johnstown Coal & Coke Co.; R. T. Blakeley, General Electric Co.; Ben Tudor, Clinchfield Coal Co.; R. D. Joseph and E. M. Thomas, U. S. Bureau of Mines

tected with ground fault relays. The authors concluded by saying, "Experience gained while operating both a-c and d-c continuous mining equipment indicated that the a-c system offered the most economical and productive operation."

"Roof Support Without Interrupting the Continous Loading," was the title of the next paper. It was given by Ben Tudor, mining engineer, Clinchfield Coal Co. who described the roof bolting practices now being used in connection with continuous mining at the Compass No. 1 Mine of the Clinchfield Coal Co. in Barbour County, W. Va. The coal seam in this area averages approximately eight ft in thickness. About seven ft of coal is taken, with 6 to 12 in. of top coal being left to prevent air slackening of the overlying shale top. To accomplish roof bolting as quickly as possible and without delay to the continuous mining equipment, two roof bolting drills are mounted on the continuous mining machine. These are of the auger type and are hydraulically operated through a system which is entirely independent of the hydraulic system of the continuous mining machine. While the miner is ripping out coal on one cut, which takes an average time of five minutes, the roof bolters on each side of the machine are busy drilling the holes and tightening bolts. The bolting crew follows a definite pattern which is coordinated with the miner's advance. Approximately one bolt per ft is used, in a 17½-ft wide room. One hundred to 140 five-ft bolts are used per shift, depending on the tonnage. Tudor concluded by saying that by mounting two roof drills on the miner itself, the company's demand for a fast, flexible, and safe means of roof bolting has been met.

The opening session was concluded with a paper on "Roof Support with Continuous Mining" by R. D. Joseph, mining engineer, and E. M. Thomas, mining engineer for roof control, U. S. Bureau of Mines. Joseph presented the paper. The authors pointed out that today continuous mining has proved itself safer, by far, than any other method of coal extraction. They went on to show that the inherent characteristics of continuous mining equipment are factors contributing to safety. Although such machines are mobile, they are immobile enough to confine mining to a definite pattern, and the underground mine of tomorrow can be expected to resemble more closely the mine on the planning board. This in turn gives rise to opportunities to use improved mine layouts; layouts in which it is possible to use the natural strength of the roof rock and the abutting pillars as support. A fixed, planned method of support applied to a fixed mining pattern could obviate errors of judgment made by workmen or job supervisors. "However," the authors went on, "an entirely satisfactory system of applying support when and where needed —one that does not impede operations —has as yet not been devised." Roof support systems used in conjunction with continuous mining are a compromise, with the general application of support being approximately 16 ft behind the cutting head.

* * * *

J. W. MacDonald, vice-president, Old Ben Coal Corp., presided as chairman of the Continuous Mining session on Thursday morning, and J. E. Elkin, general superintendent, Duquesne Light Co., was floor committeeman.

W. G. Kegel, assistant general master mechanic, Vesta-Shannopin Coal Division, J. & L. Steel Corp., spoke on "Service Haulage for Continuous Mining with Belt Turning Device." He described the Vesta-Shannopin Coal Division's work in developing a device that would allow a belt to make a right angle (90°) turn, outlining the many problems that had to be solved. Spiralling a belt around a straight pulley set at an angle to the direction of belt travel seemed to be the simplest and most direct way of changing direction, so it was fully investigated. Shop trials were made to develop construction features. Underground experiments led to further improvements. Kegel concluded that future development and use of the device can be the means of raising production and lowering costs.

Gordon L. George, superintendent, Wyatt Coal Co., discussed "Continuous Mining and Service Haulage with Colmol." He described a mechanized operation in a coal seam that averages from 42 to 48 in. height. The equipment on a section consists of one Jeffrey Colmol, one 14 BU Joy, one Long Piggyback, and three long chain conveyors. This equipment transports the coal to a belt conveyor, then into mine cars. He outlined the complete face cycle and noted that changing to conveyor haulage raised production from 310 to an average 365 tons per shift under similar conditions.

"Shuttle Cars, From Face to Intermediate Haulage" was the title of the paper given by Michael M. O'Brien, assistant superintendent, Pocahontas Fuel Co. Basing his talk on the experience of Pocahontas Fuel's Itmann Mine in West Virginia, he described the advantages of using shuttle car haulage behind the Lee Norse Miner, especially in pillar mining. Emphasizing the flexibility of such a combination, he gave an example of miner-shuttle car performance in pillar work at Itmann. The record for one unit for the year 1956 showed the monthly average to be 15,733 tons of clean coal. The average per man shift for the year was 33.8 tons of clean coal. In concluding, he stated that it was their experience that the Lee Norse miner and shuttle cars make a good, flexible, high production team for pillar mining.

"Mechanical Mining in Difficult Seam Conditions" was the subject of the paper presented by Roy M. Biggs, electrical engineer, Viking Coal Corp. After reviewing the general plant layout and seam conditions of the Viking Mine of Viking Coal Corp., he described both conventional and continuous mining methods at this operation. Continuous mining, the company found, required changes in projection and caused service haulage problems. At present the Colmol, which is operating on a trial basis, discharges coal directly onto the bottom where it is picked up with a 14 BU Joy loader and discharged onto the shuttle cars. During the month of March the Colmol unit averaged 257 tons per shift, and 28.5 tons per face man. As the operating crew becomes more experienced, this tonnage should increase.

William Laird, superintendent, Federal Mine, Eastern Gas & Fuel Associates, concluded the morning's program

Speakers at the Continuous Mining session on Thursday were, left to right, floor committeeman J. E. Elkin, Duquesne Light Co.; session chairman J. W. MacDonald, Old Ben Coal Corp.; W. G. Kegel, Vesta-Shannopin Division, J. & L. Steel Corp.; Gordon L. George, Wyatt Seanor Coal Co.; Michael M. O'Brien, Pocahontas Fuel Co.; Ray M. Biggs, Viking Coal Corp., and William Laird, Eastern Gas & Fuel Associates

with a paper titled, "Continuous Mining in Various Seam Conditions." He described and explained typical coal seam conditions, plan of mining, characteristics of the Goodman Continuous Miner, transportation of coal from the continuous mining machine to the mine car, screen analysis, ventilation, roof bolting and general conditions encountered in the employment of the Goodman Miner in the Pittsburgh Seam of coal at Federal No. 1 Mine. One section, 18 Butt Left, had a life of 119⅝ days and 179,274 tons of coal were produced from it. This is an average of 1498 tons of coal per day, 499 tons per shift and 60.7 tons per man. A total of 3315 bits were used at a cost of 0.02 cents per ton.

Conventional Mining—Still the Leading Production Method

On Tuesday morning C. E. Walker, vice-president, Jewell Ridge Coal Corp., presided over the Conventional Mining session. Floor committeeman was E. R. Phelps, vice-president, Pittsburg & Midway Coal Mining Co.

The first paper of the morning was given by R. M. Johnson, manager, Rockhouse Division, Island Creek Coal Co., who described "Mechanized Mining in Thin Seams." The greatest problem connected with thin seam mechanization, he said, has been adapting equipment to fit the seam and still operate efficiently. He described an Island Creek operation in a seam averaging 30 to 34 in. in thickness. The No. 3 Elkhorn Mine uses mobile loading machines loading on chain conveyors through a bridge conveyor to produce approximately 2500 tons of coal per day. Production is obtained from seven double-shift units of equipment. An eighth set of equipment is provided for moving. These units average 25 tons of material per man with some units producing up to 35 tons per man. In commenting on new equipment recently introduced or now in the experimental stage, Johnson said that the mechanized thin seam coal mine of the future can be expected to eventually surpass the thick seam coal mine production rates of today. This paper was published in the May issue of **Mining Congress Journal.**

"More Tons Per Man with Large Mine Cars" was the interesting title of the paper prepared by John R. Palin, chief engineer, Harmar Coal Co. He outlined the modernization of the Oakmont Mine, acquired by Harmar Coal Co. in 1952. Revamping the haulage and purchasing new large mine cars was the major part of the modernization. Physical size of mine car studied was 30 ft overall length, 7 ft wide by 48 in. high, and capable of traveling on a 2½ turnout. The 30-ft length is believed to be a record to date for cars used strictly for underground haulage. With the new haulage facilities, flow of coal

Speakers at the Tuesday morning session on Conventional Mining were, from left to right, C. E. Walker, Jewell Ridge Coal Corp., session chairman; R. M. Johnson, Island Creek Coal Co.; John R. Palin, Harmar Coal Co.; C. S. Winters, Powhatan Mining Co.; Courtney C. Quirey, Sr., Pittsburg & Midway Coal Mining Co.; C. N. Van Houten, Tennessee Coal & Iron Division of U. S. Steel Corp., and E. R. Phelps, Pittsburg & Midway Coal Mining Co., who served as floor committeeman

is as follows: Cars are dumped into a 325-ton capacity hopper, all coal being fed into a rock type 30 by 60-in. single roll crusher, by a vibrating feeder, where the product is reduced to minus three in. Discharge from the crusher is onto a 60-in. transfer belt conveyor on 25-ft centers to a 36-in. slope belt. The slope belt is on 816-ft centers and terminates at a two-bin structure on the river front. Flow of coal is through the bin to a vibrating feeder to a 36-in. belt to a barge loading chute. Proof of improved haulage and coal handling into barges can be seen from the fact that for the six months period before the change-over output averaged 11.1 tons-per-man-day, as compared with 14.3 for a similar period after the change-over.

C. S. "Pat" Winters, superintendent, Powhatan Mining Co., considered the aspects of high speed operation in his talk on "High Speed Mine Haulage." Modernization of the haulage at Powhatan No. 1 Mine was undertaken when it became evident that the system then in use was inadequate, costly and very impractical for an increased tonnage. The program set up, and still in process of being carried out, involved new cars of greater capacity, some increase in haulage speed, new dumping facilities, and a general overhaul of the motor road. In the past, a locomotive crew running from face to dump hauled approximately 80 tons. Today that same crew with a speedier locomotive, larger cars, and heavier track has reduced the travel time and increased the tonnage to 300 tons for the same trip and manhours. Winters also emphasized the importance of personnel efficiency, noting that the machine is only as valuable as demonstrated by its operator.

"All Belt Haulage and A-C Power Underground at DeKoven Mine" was the title of the next paper which was given by Courtney C. Quirey, Sr., superintendent, DeKoven mine, Pittsburg and Midway Coal Mining Co. He described the DeKoven mine which started production on the West Kentucky No. 9 seam in the fall of 1956. The latest developments in modern mine equipment and procedures were utilized in the design and development of the underground operations and the coal handling and preparation facilities. The feature of the underground operation is the use of a-c power, and the feature of the overall operation is its flexibility. Facilities for the handling and storage of raw coal and washed coal make it possible to operate the mine, the preparation plant and the loading of washed coal independently. Although designed primarily for river transportation, facilities have also been provided for loading of railroad cars.

C. N. Van Houten, superintendent-maintenance, Coal Mine Works, Tennessee Coal & Iron Division, U. S. Steel Corp., concluded the session with a paper titled "Maintenance—A Tool for Increased Production." He listed the important phases of the general maintenance program at T.C.I. mines as follows:

1. Provide personnel on each operation section to take care of minor repairs and adjustments.
2. Provide underground shops to take care of heavier repair and to maintain miscellaneous equipment throughout the mine.
3. Provide a sufficient number of spare operation sections to permit scheduled shutdown of regular operating sections for general repairs.
4. Provide surface shops for maintenance of surface facilities and for complete overhaul of component subassemblies and entire machines.
5. Provide other miscellaneous services which will reduce delays to a minimum.

Van Houten emphasized the importance of complete, accurate and usable records, calling them the foun-

Speakers at the Conventional Mining session on Wednesday morning were, from left to right, floor committeeman Harold L. Beattie, Elk River Coal & Lumber Co.; S. A. Caperton, Slab Fork Coal Co., session chairman; J. W. Bassett, West Kentucky Coal Co.; Robert E. Spoerl, U. S. Rubber Co.; W. C. Schott, Stonega Coke & Coal Co.; C. C. Conway, Clarkson Manufacturing Co., and D. C. Ridenour, Olga Coal Co.

dation and primary prerequisite to a modern maintenance program. He also covered training of maintenance personnel and described a company-sponsored maintenance school.

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With S. A. Caperton, president, Slab Fork Coal Co., as chairman, the second session on Conventional Mining was held Wednesday morning. H. L. Beattie, vice-president, Elk River Coal & Lumber Co. was floor committeeman.

"Major Factors in Belt Conveyor Haulage" was the first speaker's subject. J. W. Bassett, mining engineer, West Kentucky Coal Co., stressed the importance of not overloading panel belts, good housekeeping, and proper lubrication. He listed the advantages of concentrated mining with belt haulage and noted the low accident rate with this type of haulage. He concluded that, with competently trained belt crews, down time resulting from using belt haulage can be reduced to less than one percent, and estimated that 20 cents per ton will take care of belt replacement and maintenance—based on a 1,500,000 to 2,000,000 ton per year mine.

Robert E. Spoerl, chief belting sales engineer, United States Rubber Co., discussed "Advantages of Belt Haulage in Coal Mining." Belt conveyors follow level or pitching terrain and can handle grades up to 30 percent. The distance that belting can convey coal is unlimited. Conveyors require little preparatory construction and erection and underground they allow the use of narrow entries with low headroom as haulage ways. Belt haulage is smooth, silent and provides low power consumption with a uniform power factor. Safety and low cost per ton of coal carried were other advantages Spoerl listed. He emphasized the importance of good maintenance and accurate service records.

"Training and Instructing Mine Mechanics in Shop and Shop School," was the topic of the next paper, presented by W. C. Schott, vice-president and general manager, Stonega Coke and Coal Co. He explained how his company, faced with a shortage of mechanics, decided to institute an extensive training program to accomplish the dual purpose of providing mechanics to augment its present mine repair force and also to provide a force capable of rebuilding and reconditioning the mine equipment which requires this type of work. Personal interviews and aptitude tests were used in selecting trainees. The company set the following potential time schedule: First six months—basic training; 6 to 12 months—evaluating period; 12 to 18 months—helpers; after 18 months—to mine mechanics. The trainees work with trained mechanics and electricians in the Central Machine Shop primarily on the rebuilding and rehabilitation of equipment. In conjunction with this work, a lecture and classroom study program was initiated. The basic fundamentals of lubrication, hydraulics, mechanics and electricity are explained and illustrated. Representatives of some of the manufacturing companies give lectures on various phases of care and maintenance, construction, including mechanics, electricity, and hydraulics. This program has been in effect seven months and has proved satisfactory.

In presenting his paper, "Problems and Advantages of A-C Power for Face Machines," C. C. Conway, electrical engineer, Clarkson Manufacturing Co., notes that the industry has now approached an average power consumption of ten kwh of energy per ton of coal produced. After listing some of the problems caused by power loads continually growing heavier and more concentrated, Conway discussed the suitability of a-c motor characteristics to most underground mining loads and a general substitution of a-c for d-c insofar as practical. He compared a-c motors with d-c, listing the advantages as well as the limitations of each, and commented on the distribution of power in an a-c miner. Primary power distribution in an a-c machine may not be affected, he said, but the secondary system presents many new considerations. First, a-c motors require better voltage regulation than d-c motors, as do also their controls. The particular problem is that a-c motors require six or more times full load current for starting. This heavy starting current causes heavy voltage drops in the power system so that there are two principal results.

A. The voltage drop may become great enough so that the a-c contactors pull out.

B. Assuming that contactor drop-out troubles were circumvented, then the voltage drop might be such that the torque would be affected and proper starting would not take place.

D. C. Ridenour, chief engineer, Olga Coal Co., concluded the morning's program with a paper titled "Core Drilling of Air Shafts and Manway Portals." He described his company's experience in drilling a 36 in. and a 48 in. diameter Calyx hole, outlining methods and equipment employed. To be used as air shafts, the holes were drilled a depth of 733 and 976 ft respectively. The cost of drilling these holes varied with diameter, depth, geographical location, surface conditions, rock strata and water. There are other uses for this type of hole by the mining industry in addition to ventilation. One of the most important, Ridenour said, is the use of five and six-ft diameter holes as manway portals equipped with elevators.

Coal Preparation Gets More Complex

Concurrent with the Conventional Mining session on Tuesday morning, a Coal Preparation session was held under the chairmanship of George J. Clark, president, Reading Anthracite Co. J. W. Broadway, vice-president, Bell & Zoller Coal Co., served as floor committeeman.

E. M. Robinson, superintendent of preparation, Jeddo-Highland Coal Co., described the "Jeddo No. 7 Fine Coal Cleaning Plant." This froth flotation plant reclaims fine coal from anthracite sludge. Designed to make a cut at 100 mesh, the plant uses riffle-type launder screens to effect a sharp classification. The plant feed of 2160 gpm contains approximately ten percent solids or 62 tph. After entering the cleaning plant, the feed is split and passes over two launders (ripple screens) to remove the plus 3/64-in. material. The overflow of these launders is dewatered by means of a screen and cleaned in a hydrotator. The underflow of the top (No. 4) launders passes over two No. 5 laun-

ders. The underflow of these launders goes to waste. The overflow is cleaned by means of a froth classifier and cyclones. Due to modern design and automatic equipment, only one operator is needed inside the plant. This paper appeared in the May issue of MINING CONGRESS JOURNAL.

"A Discussion of Fine Coal Recovery Equipment" was the title of the next paper, prepared by Wm. C. McCulloch, Coal Preparation Manager, Roberts & Schæfer Co., and in his absence was read by his assistant, J. D. Wender. After reviewing the problems of fine coal recovery, he discussed the many recovery processes. In the category of simple reclamation, there are many types of thickening and filtering. In the category of cleaning, Mr. McCulloch listed the processes of froth flotation, Convertol, slime tabling, jigging, and classification. In concluding, he pointed out the alternate approach of air washing, thereby eliminating the sludge problem.

Two men combined their talents to prepare the next paper entitled, "Water Clarification at Robena Cleaning Plant." They were Paul L. Richards, manager, coal preparation, Coal Division, who presented the paper, and John C. Durfee, superintendent, Robena Cleaning Plant, United States Steel Corp. The installation at the Robena Coal Preparation Plant is an example of what can be done by industry toward abatement of the stream pollution problems. Constructed in 1948, the design capacity of the Robena Plant was originally 600 tph but was later expanded to 800 tph during the first six months of operation. The plant was designed for closed circuit operation to permit maximum recovery of usable coal and to prevent stream pollution. Coal finer than ¼ in. was classified at 28 mesh. The coarser fraction was tabled directly. The minus 28 mesh was thickened in a 180 ft diameter thickener and then tabled. The combined clean coal was mechanically dewatered in solid bowl centrifuges. Thickener overflow and centrifugal filter effluents were returned to the plant circuit for re-use In 1951 plans for the expansion of capacity to 1200 tph were completed. The new facility included an additional 180 ft diameter thickener where the overflow of the primary thickener would be flocculated. Bowl classifiers for disliming the original table feed were also included. Maximum recovery of fine mesh coal is now possible, and most of the plant water is reused after virtually complete clarification.

"Preventing Stream Pollution" was the title of a paper presented by H. F. Hebley, research consultant, Pittsburgh Consolidation Coal Co. He provided a general sketch of the problems that face the coal industry in regard to water pollution. In attacking the problem of acid drainage water discharged to the stream system, Hebley discussed two approaches that can be explored: (1) Treatment of acid forming material in the mine in a manner that acid formation will be inhibited, and (2) Neutralization of acid mine drainage before the discharge reaches the stream system. He also listed the various equipment available for removal of suspended solids from washery water discharges.

At the Tuesday morning session on Coal Preparation speakers were, left to right, session chairman George J. Clark, Reading Anthracite Co.; E. M. Robinson, Jeddo-Highland Coal Co.; P. L. Richards, U. S. Steel Corp.; H. E. Hebley, Pittsburgh Consolidation Coal Co.; Larry Cook, Ohio Reclamation Association; John C. Durfee, U. S. Steel Corp., and J. W. Broadway, Bell & Zoller Coal Co., floor committeeman

Larry Cook, executive vice-president, Ohio Reclamation Association, talked on "Preventing Stream Pollution in Strip Mines." He reported on the methods being used in surface mining operations in Ohio to prevent the pollution of water. Cook noted that pollution of water in surface mining operations falls into three types: suspended solids, acids, and discoloration. Settling basins of varying kinds are used in many of the operations to solve pollution. Other methods include segregating acid bearing material, covering it where possible to prevent it from oxidizing, and segregating the water from the acid bearing material. Gob is a source of acid which is being given more attention by the operators. Some are trucking it back into the spoils and burying it; others are placing it in a depression where it can be flooded. The most positive means yet discovered of inhibiting the formation of acid, according to Cook, is the method of preventing the air from getting to potentially toxic material by covering it with water. This method has been used with a good deal of success in Ohio.

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A second session on Coal Preparation was held on Thursday morning. David Ingle, Jr., president, Ingle Coal Co., was session chairman. "Trends in Modern Cleaning Plant Design" was the title of the first paper. It was presented by Loy A. Updegraff, project engineer, of Bituminous Coal Research, Inc. After describing mining and market trends at home and abroad, Updegraff went on to describe preparation equipment now commonly available in this country. He predicted that techniques in flocculation, froth flotation, and other means of water clarification and recovering suspended fine coal will find increasing application in the design of new cleaning plants. New methods of cleaning, screening, dewatering and drying of fine coal in the approximate size range of 28m by 0 are advancing and will soon be included in plant design where they are needed. This complete paper appears on pages 63 to 68 of this issue of MINING CONGRESS JOURNAL.

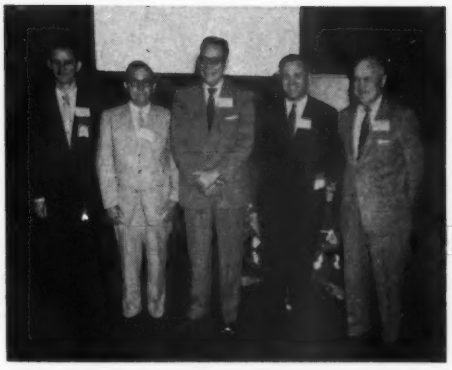
Jack M. Bishop, chief chemist, Truax-Traer Coal Co., followed with a discussion of the Updegraff paper. Bishop first outlined the work of the American Mining Congress Committee on Coal Preparation. He then went on to discuss the evolution of modern coal preparation, saying that the ultimate in coal preparation is to reduce the ROM feed to its basic constituents for reassembly into a product to conform to market demand. He said the ultimate in plant design and construction has never been reached and will continue to present an ever rising mesa as long as research and engineering continue to advance. He concluded by discussing automatic controls, freeze prevention and automatic sampling practices.

Next on the program was A. P. Massman, coal preparation manager, Peabody Coal Co., whose paper was entitled, "Coal Drying and Dust Collection at Lynville Coal Co." The first fluidized dryer in the coal industry has been in operation at the Lynville, Ind., plant since July 1955 drying 70 to 100 tons of fine coal per hour. Generally, the Dorrco FluoSolids Drying System at Lynville is made up of a two-compartment reactor in which air for drying is heated and in which fine coal is dried, a pulverizer to crush coal used as fuel, cyclones

to recover solids entrained in the exhaust gases, and auxiliary equipment including blowers, instruments, feeders and bins. Since October, 1955 the dryer has been handling coal up to ¼ in. by 0 having a surface moisture from 11 to 12 percent. Moisture of the dry coal varies between 3 and 4 percent. Designed to dry 70 tons of coal per hour, the installation has handled as much as 107 tons per hour without any indication that the maximum flow has been attained. Massmann concluded by saying, operating costs are estimated to be about eleven cents per ton of wet feed. Power consumption for all equipment associated with the drying system varied from 331.3 kwh at 88 tons per hour feed to 338.3 kwh at 97 tons per hour feed.

E. R. McMillan, manager, coal operations, Northern Pacific Railway Co., coal department, described "Fine Coal Cleaning with the Feldspar Jig." McMillan said that increased minus ¼-in. coal, brought about by the introduction of continuous mining equipment, at his company's properties was overloading the tables used to clean this particular size. Faced with the necessity of increasing fine coal cleaning capacity, a decision was made to have the MacNally Pittsburgh Manufacturing Co. construct a feldspar jig. Designed to treat a maximum of 75 tph of minus ¼-in. feed, the jig is standard Baum type, two-compartment, four cell unit with two reject elevators, one for refuse and one for midlings. The feldspar type jig uses a false bed of material on top of the screen plate. Holes in the plate are larger than the top size of the feed and the bed material is larger than the screen holes. McMillan typified the operation of the feldspar jig as washing through the screen rather than over the screen. The most delicate and important control is the automatic control of water and air adjustments. At McMillan's operations, instead of feldspar, the false bed consists of burnt shale from the company's gob piles. Raw coal feed is ¼ in. by 1 mm and the midling product is recirculated. McMillan concluded by saying that the unit has been looked upon by his company as an experimental unit until this time. Results have been encouraging, however, and they anticipate that the jig will fulfill all the requirements that have been put down.

The last paper of the session, "The Twin-Deck Suspension Type Coal Washing Table," was jointly prepared by F. S. Ambrose, consulting engineer, Fairmont Machinery Co., and D. H. Davis, vice president, Mathies Coal Co. Davis presented the paper. In its essentials, the unit is a two-deck table which is suspended from overhead supports. The head motion is rigidly connected to the twin deck. These features provide the advantage of doubling table capacity with the added benefit of having the smoother operation permit structures of lighter construction. During the experimental period at Mathies it was determined that the capacity per deck is ten tons per hour with a ⅜-in. by 0 raw coal feed containing 21 to 22 percent 1.60 specific gravity sink material. Tests indicate that the water requirements are the same as that for a conventional single-deck table.



Discussing Coal Preparation Thursday morning were, from left to right, session chairman David Ingle, Jr., Ingle Coal Co.; Loy A. Updegraff, Bituminous Coal Research, Inc.; Jack M. Bishop, Truax-Traer Coal Co.; A. P. Massman, Peabody Coal Co., and E. R. McMillan, Northern Pacific Railway Co. D. H. Davis, Mathies Coal Co., also spoke but was not present when the picture was taken

Strip Mining—Both Large and Small Machines Have Their Place

The first strip mining session of the convention was held Tuesday afternoon with G. E. Sorensen, president, Kemmerer Coal Co., as chairman, and W. H. Moore, general superintendent of mines, Susquehanna Collieries Division, The M. A. Hanna Co., as floor committeeman.

Fred Horne, explosives engineer, Peabody Coal Co., presented a paper entitled "Overburden Drilling and Blasting with Ammonium Nitrate Explosives." So much has been written and said during the past few years concerning rotary drilling that a newcomer to the mining industry might be inclined to believe that this method of drilling has completely replaced all other methods, Horne said. To illustrate the fallacy of this thinking, he pointed out that at all of Peabody's stripping operations during December 1956, a total of 8,290,769 cu yd of material was shot from auger drill holes; 1,287,829 cu yd were shot from rotary drill holes, and 50,642 yd of material was prepared from percussion drill holes. The type of overburden encountered will dictate the type of drilling used which can be exclusively horizontal or exclusively vertical or a combination of both, Horne said. All drilling systems have certain advantages but, likewise, have some disadvantages.

After discussing the problems of shooting against a "buffer," Horne discussed the trend toward large diameter drill holes. He then discussed blasting agents and said that if the term "ammonium nitrate explosives" is considered in the broad sense to include ammonium nitrate dynamites, in which various percentages of nitroglycerin have been replaced by ammonium nitrate, as well as the explosives consisting of various grades of ammonium nitrate reinforced with oxidized materials such as carbon black, coal dust or fuel oil, it can be stated that practically all fixed explosives now used by the strip mining industry can be so classified. In a discussion of blasting cost, Horne described delay blasting and a machine that has been put into operation in a Southern Illinois coal mine to mechanically load and tamp horizontal drill holes.

Next on the program was a joint paper describing "A New Liquid Oxygen Explosive" by D. W. Mogg, project supervisor, Great Lakes Carbon Corp., and C. C. Woolsey, drilling and shooting superintendent, The Enos Coal Mining Co. It was pointed out that, assuming the liquid oxygen is of high purity, differences between various carbon-liquid oxygen explosives are entirely due to differences in the carbon. The author described a new LOX carbon and reported the results which have been obtained in blasting overburden with this explosive in the pits of The Enos Coal Mining Co. The paper, describing the properties of the recently developed explosive and field experiences, including costs, was published in the April issue of **Mining Congress Journal.**

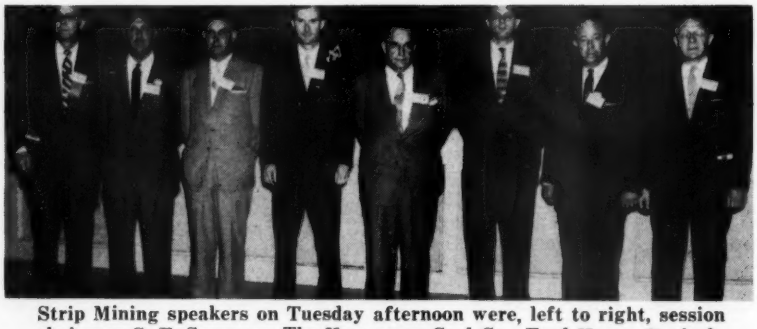
The afternoon session was concluded with three speakers describing different types of earth moving equipment now being used in moving overburden in our nation's coal strip mines.

"Large Shovels in Heavy Cover," were discussed by T. G. Gerow, mining consultant and engineer, Chicago. He stated that big stripping units are definitely in the picture today and in the future, and further stated that higher capacity machines are coming.

After tracing the development of stripping shovels to the present day, Gerow pointed out that basically there has been little change in shovels or digging principles since the first stripping shovel was built. He said that strip mine operators are still looking for more capacity and more range in prime movers. Today, shovels are giving capacity and draglines are giving range, however, both properties have not yet been included in a prime mover. The complete text of Gerow's paper appeared in the May issue of MINING CONGRESS JOURNAL.

R. E. Dougherty, Jr., vice-president, Tasa Coal Co., discussed "Medium and Small Shovel Operations." He stated that the need for small and medium size stripping equipment is not passed in spite of the constant drive for additional yard-moving capacity. The size of earth moving equipment for strip mining is generally determined by several considerations, usually including: (1) acreage of strippable coal; (2) operational mobility; (3) local topography, and (4) operational balance. Following a discussion of these factors, Dougherty described a strip mine operated by his company in West Virginia at which four seams of coal are strip mined.

Harry H. Hughes, general superintendent, J. Robert Bazley, Inc., presented a paper on "Overburden Removal with Scrapers and Bulldozers in Anthracite Strip Mining." Although the role of the bulldozer and scraper units in coal stripping in the past has been that of auxiliary equipment, conditions now exist where the economics of bulldozer and scraper operations can be justified. At some of the present-day deep strip pits in the anthracite region, available dragline equipment cannot handle the overburden in one pass. Occasionally a shortage of spoil room aggravates this situation. Under conditions such as these, high-speed rubber-tired scrapers have been well accepted as primary units in removing the top level of the overburden, thus relieving the dragline operation. At these operations it is often advisable to use a bulldozer as a pusher during the loading cycle. Hughes concluded with a description of a scraper operation being operated by his company. At this mine 30-ft of coal, overlain by 65-ft of sandstone and 70-ft of heavy clay, are being mined.



Strip Mining speakers on Tuesday afternoon were, left to right, session chairman G. E. Sorenson, The Kemmerer Coal Co.; Fred Horne, Peabody Coal Co.; C. C. Woolsey, The Enos Coal Mining Co.; D. W. Mogg, Great Lakes Carbon Corp.; T. G. Gerow, Chicago; R. E. Dougherty, Jr., Tasa Coal Co.; Harry H. Hughes, J. Robert Bazley, Inc., and floor committeeman W. H. Moore, Susquehanna Collieries Division of The M. A. Hanna Co.

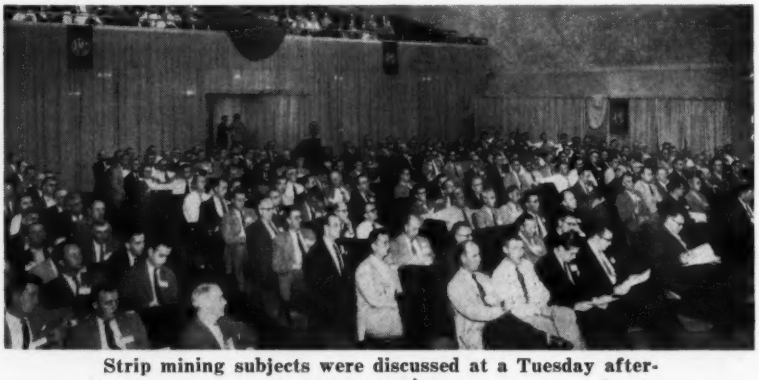
* * * *

A second strip mining session was held Wednesday morning. W. J. Rude, Assistant vice-president, Central Ohio Coal Co., presided as chairman. Andrew Hyslop, Jr., chief engineer, Hanna Coal Co., was Floor Committeeman.

"Portable Power Systems for Strip Mines," was the topic of the first paper and was presented by L. E. Briscoe, electrical engineer, Ayrshire Collieries Corp. After tracing the growth of electrical energy demands in the nation's mines over the past 30 years, Briscoe described the portable power policies that have been in use by Ayrshire Collieries Corp. in their strip mines. He stressed the value that his company has discovered in using parallel transformer portable power distribution systems. Cautioning that two half-size transformers operating in parallel side by side would not have the advantage of one full-size transformer at all times, he pointed out that the advantages would appear only when a large physical distance existed between the transformers. He said that his company's analyses have proved conclusively the advantages of parallel operation of transformer for portable power distribution system for strip mining, and that these advantages become more pronounced as the equipment increases in size. He predicted that similar power distribution systems will be installed in other operations as equipment increases in size and pit operations increase in length.

B. E. Rector, Westinghouse Electric Corp., in discussing the above paper, pointed out that the layout of the distribution system involves three primary factors. The system must be capable of supplying the load equipment without objectionable voltage regulation from an operating standpoint and at the same time stay within reasonable economical limits. Second, the system must provide adequate standards of safety to both personnel and equipment. Third, the units compromising the system must be adaptable to relocation in order to keep up with the changes in load requirements. Rector added that, in cases where the substation remains fixed for relatively long periods of time, the difference in first cost of portable versus stationary units must be analyzed and weighed against the costs of moving the equipment. He followed with a discussion of ground protective systems and an outline of the trend to higher voltages.

Turning from power to maintenance, the next speaker was R. L. Rectenwald, president, Maintenance Engineering Corp., who described "An Engineering Approach to Rehabilitation of Large Castings and Forgings." Using the basic thesis that anything built from man-made materials can also be rebuilt or repaired by manual skills and ingenuity, Rectenwald described techniques of welding, me-



Strip mining subjects were discussed at a Tuesday afternoon session

At the Wednesday morning session on Strip Mining speakers were, left to right, session chairman W. J. Rude, Central Ohio Coal Co.; L. E. Briscoe, Ayrshire Collieries Corp.; B. E. Rector, Westinghouse Electric Corp.; R. L. Rectenwald, Maintenance Engineering Corp.; B. N. Carlson, American Steel & Wire Division, U. S. Steel Corp.; Emil Sandeen, Pittsburg & Midway Coal Mining Co., and Andrew Hyslop, Jr., Hanna Coal Co., floor committeeman

chanical joining of materials and location machining of equipment in the field, showing how these operations have been developed to minimize disassembly, outage time and replacement costs. His highly informative paper is presented in full beginning on page 66 of this issue of MINING CONGRESS JOURNAL.

B. N. Carlson, chief wire rope Engineer, American Steel & Wire Division, United States Steel Corp., followed with a report on "Inspection and Maintenance of Wire Rope to Extend Rope Life." Proper maintenance of wire rope should start even before the rope is placed in service because the beneficial results of excellent equipment maintenance can be nullified by careless handling and storing. Cautioning that in order to obtain efficient rope performance each wire must carry its share of the load, Carlson described various conditions which do not allow this condition to exist. Two of these conditions are nicked, or cut, wire strands and corrosion. The need for adequate lubrication was explained and practices of field lubrication were outlined. Carlson said that when one end of the rope is more heavily worn than the other, its life can be extended by turning the rope end for end and that rope life can be further extended by watching sheave and drum wear. He concluded by saying the significant benefit that is derived from a comprehensive inspection of maintenance procedure is that rope life can be safely extended. Through proper care the hazard of unexpected failure can be largely eliminated, and the consequent extensive shutdown of equipment can be avoided. The end result is reduced mining costs.

"Strip Mine Maintenance Based on 30 Years Experience," was the title of the final paper of the session and was presented by Emil Sandeen, superintendent, Pittsburg & Midway Coal Mining Co. A good preventive maintenance program is the way to automatically lessen the number of breakdowns that otherwise would require extensive maintenance facilities, Sandeen said. The need for maintenance has always been with us, but this need has become more pronounced in the face of rising costs. The author then went on to describe the maintenance system now being used by his company. He stressed the value of cleanliness, not only as an aid to maintenance, but as an important factor in safety and in establishing worker pride.

Management and Safety—Importance Stressed

Management and safety occupied the attention of convention-goers Wednesday afternoon. The session was under the chairmanship of L. C. Campbell, vice-president, Eastern Gas & Fuel Associates, and Chairman of the Coal Division of the American Mining Congress. W. A. Gallagher, vice-president, Stonega Coke & Coal Co., was Floor Committeeman.

The first speaker was J. S. Whittaker, general superintendent, Pittsburgh Coal Co., who spoke on "Mine Fire Hazards and Fire Fighting Equipment." He stressed the importance of (1) preventing fires from occurring, and (2) maintenance of equipment, and (3) training in the procedures to be used in fire fighting. Whittaker said that his company is attacking the problem of fire prevention by the education of machine operators, extended use of circuit breaker protection for face machines, and improved maintenance in general housekeeping of electrical equipment. In the line of fire fighting equipment, his company has purchased for each operating unit a 150-lb capacity dry chemical tank mounted on wheels, and has installed on each section from two to four 20 and 30-lb dry chemical extinguishers. Within the past year each mine has been equipped with two or more fire cars having a capacity of 2200 gal of water. The centrifugal pump on each car is capable of delivering 100 gpm of water at 90 psi nozzle pressure throuugh 600 ft of two-in. hose. In addition, 1000-gal capacity fire cars, capable of delivering 100 gpm of 80 to 100 psi, are available for emergency service.

Each working section in the larger mines is equipped with a two-in. spray line for dust control at the working face. These lines have outlets every 200 ft where hose can be attached for fire fighting. Mine drainage lines are equipped with fire hose outlets at 500-ft intervals along haulage roads. To insure the most efficient use of available fire fighting equipment, foremen and workmen in the mines are instructed on the job at least three times each year in fire fighting techniques.

Then followed a paper by Charles Ferguson, safety director, United Mine Workers of America, who spoke on the "United Mine Workers Role in Accident Prevention." At the beginning of his paper Ferguson pointed out that, "Until such time

The Wednesday afternoon session on Management and Safety had as speakers, from left to right, Wm. A. Gallagher, Stonega Coke & Coal Co., floor committeeman; session chairman L. C. Campbell, Eastern Gas & Fuel Associates; J. F. Whittaker, Pittsburgh Coal Co.; C. B. Ferguson, United Mine Workers of America; G. W. Lockin, Inland Steel Co.; C. R. Nailler, Christopher Coal Co.; F. Earle Snarr, Freeman Coal Corp.; James Hyslop, Hanna Coal Co., and H. E. Mauck, Olga Coal Co.

as the industry injury rate does not include those which could be prevented by reasonable precautions, UMWA will continue to operate with determination through every channel at its disposal in an attempt to revise the story of unnecessary death and injuries to its membership." He then went on to explain the operations of the safety division of the International Union and outlined some of the activities carried on in various union districts which are authorized to originate and carry on programs designed to meet their particular needs. After explaining a procedural program which was adapted for the handling of safety grievances, Ferguson stressed the need for education in a concerted effort in the battle to reduce coal mine injuries. He pointed out that the advances that have been made in mine safety during the past few years are anything but discouraging and that he strongly felt the matter of safety education is one in which progress is being made daily.

This paper was followed by three prepared discussions. One was given by James Hyslop, president, Hanna Coal Co.; another by Earle Snarr, vice-president Freeman Coal Mining Corp.; and the third by H. E. Mauck, general superintendent, Old Coal Co.

Hyslop stated that management can never escape the fact that it must carry the full responsibility for mine safety. He continued that it seemed to him that one of the contributions which management can make to any safety program is to recognize that it (management) has responsibility to see that relations and negotiations with mine workers with respect to safety matters are maintained on a proper level of decency and cooperation. He concluded by saying that he was confident that industry will do so.

Snarr stated that," Safety is, among other things, a state of mind," and that, "Nothing can compensate for lack of enthusiasm or lagging interest in this subject." He went on to point out that a clear and practical statement of policy with respect to accident prevention on the part of both mine workers and management can render a valuable service. In outlining one of the critical aspects of safety management, the problem of worker discipline, Snarr stated that it was his opinion that the best disciplinary influence is the ability of a foreman to instruct and inspire his men. He also stressed the point that the final responsibility for safety lies with management, and that in mine management it is not the safety department that is responsible for the working habits of the men, but it is the foreman immediately in charge of the men.

In the last of the three prepared discussions, Mauck supplemented suggestions given in the Ferguson paper on improving safety records at mines or companies which are below certain levels with the following list: (1) each operators' association should have an active safety committee and this committee should concern itself with the accident records of its membership; (2) State and Federal inspectors should be encouraged to promote the adoption of proven ideas and methods in backward properties; (3) operators should encourage their managers and supervisors to visit neighboring mines with a view to becoming familiar with effective safety programs, and (4) that mine workers can make improtant contributions to improving a bad safety record. Mauck also underlined another suggestion made in the Ferguson paper; that of having Federal and State inspections arranged so that they do not overlap and that they fall at least one month apart.

C. R. Nailler, president, Christopher Coal Co., followed with a paper on "Selection of Coal Mine Personnel Through Testing." Christopher Coal entered the field of personnel testing because it felt that it was doing a poor job of selecting supervisory personnel and, to a lesser degree, in selecting UMWA employes. Nailler discussed briefly how the tests that the company now uses were selected and how they are administered. There are two sets of tests, one set of two for mine employes, and another set of two for supervisory employes. At the present time tests are given to all applicants for employment. Personnel testing and meticulous preemployment screening has given a tremendous boost to the company's "batting average" in predicting success on the job. This has been the case with both supervisory employes and UMWA employes. However, he went on to point out, even if tests can perform an effective job of selecting men with the right talents for given positions, there is such a thing as putting too much reliance on them. A company can fool itself by selecting too readily "scientific" numerical answers as a substitute for human decisions about people.

The entire text of this paper was carried in the April issue of MINING CONGRESS JOURNAL.

"A Method Study Procedure for Improving Face Costs," was the title of the final paper of the afternoon. It was given by G. W. Lockin, production engineer, Inland Steel Co. Inland Steel took 2½ years to time study the cycle problems on all sections and covered all existing conditions and equipment combinations in its coal mines. By gradually introducing a program, rather than installing it as if it were a piece of equipment, the company feels that it will have lasting values, particularly in the attitudes of mine management personnel. Lockin described the method study procedure now being used by his company as simply a process of graphically or symbolically plotting work procedures for later analysis, and the application of work economy principles. He explained that this procedure at Inland Steel is still in an experimental stage and that from all available evidence, it appears to be adaptable to mining and to be useful in applying the principles of work economy which result in reduced face costs.

Safety Committee Formed

Coal Show week also saw the organization of a Committee on Safety within the framework of the Coal Division of the American Mining Congress. Committee membership is made up of the directors of safety for several leading coal producers from all sections of the country. Ralph Kirk, Consulting Engineer, Birmingham, Ala., is chairman.

At an organization luncheon on Wednesday, the primary aim of the Committee was described as, "to provide a forum for free discussion and exchange of experience concerning present and potential hazards in the progressive modernization of coal mines." The Committee's work is not intended to duplicate the activities of other organizations or agencies dealing with mine safety. Primarily the purpose is to take a forward-looking approach to the further prevention of coal-mine casualties by early study of the engineering aspects of equipment recently developed or in the process of development and to formulate recommendations for operating practices and equipment design that will minimize hazards in mine operation.

Land and Water Use

A joint luncheon meeting of the Land and Water Use Committees of the American Mining Congress and the National Coal Association was held on Wednesday. A full agenda was disposed of as members of both organizations discussed the problems of land use, water and air pollution and related problems in connection with mining.

Fun and Relaxation

On Wednesday night the Coal Miners Party was held in three sections, two at the Statler and one at the Carter Hotel. An outstanding evening, including dining, dancing and a scintillating floor show was enjoyed by the large mining crowd.

Ladies attending the Coal Show also enjoyed a series of special events that had been planned for their entertainment. These included a Welcoming Luncheon featuring the noted caricaturist, Lenn Redman; a sightseeing trip aboard the "Carol Diane," along Lake Erie and up the Cuyahoga River to view this great industrial valley with its docks, steel mills and

Ladies attending the AMC Coal Show enjoyed a number of special parties in their honor

ore refineries; and on Wednesday, a special luncheon at which the ladies were entertained by Jo Portaro, internationally known hair-styling and beauty authority.

Excellent Presentations on Industrial Minerals Program

Felix Shay, vice-president, Foote Mineral Co., and J. N. Suliot, manager, Eastern District, Michigan Limestone Division, U. S. Steel Corp., served as co-chairmen, in place of T. M. Ware, vice-president, International Minerals & Chemical Corp., at the first of two "round table" sessions on Industrial Minerals.

John C. Vonderau, quarry foreman, Michigan Limestone Division, U. S. Steel Corp., in his paper, "Effect of Various Changes in Drilling and Blasting Practice at Hillsville Limestone Quarry" described measures taken by his company to attain optimum drilling and blasting efficiency in extracting a flat-lying, 22-ft thick vein of limestone which lies under 25 to 120 ft of overburden. By experimenting with hole sizes which had formerly been 1⅝ in., it was found that 2½-in. holes gave the best overall results and decreased the drilling required—because the drill pattern could be expanded. It was also found that these bigger holes permitted the use of less expensive explosives in many instances. Drilling time was further reduced by the purchase of newer self-propelled, power-feed drills which resulted in a striking reduction in labor costs. It is interesting to note that at the Hillsville Quarry it was found highly advantageous from both the cost and convenience standpoints to eliminate a six-in. airline from the central compressor station, using instead two portable 900-cfm diesel-driven compressors. Blasting studies are being made to determine whether a change in the explosive used could not effect a further saving.

One of the newer management engineering techniques was cleared up for many listeners by Gershon Cooper, research director, Dunlop & Associates, Inc., during his presentation, "Operations Research—Key to Effective Planning of Mining Operations." Cooper showed how Operations Research can be applied as an aid in decision making by men at high management levels. Using a definite mining situation he showed how this technique may be applied to analyze and evaluate such factors as the magnitude of expected profits, the timing of expected profits, the effect on profits of uncertain future events, and the likelihood of large deviations—positive or negative—from the expected profits. In working out this project all feasible alternatives were considered and compared one to the other. Cooper went on to state that many operations research projects do not identify a "best" decision, for the best decision depends, in part, upon judgments about some unanalyzed aspects of the future. The judgments and the intuition of the decision-maker have to be applied, and upon his judgment of such matters, in conjunction with the analysis itself, the decision has to rest. Operations Research is one of the alternatives open to management, and one which it would be foolhardy to ignore.

The recent trend to the use of heavy media separation in the production of specification gravels was traced by William L. Price, engineering manager, Keystone Division, Dravo Corp., in his presentation, "Current Developments in Gravel Beneficiation." The first H. M. S. plant for the treatment of gravel was put in operation in 1948. There are now a total of nine of these plants. Reasons for this step into a relatively expensive process, Price said, are that many of the best deposits have been worked out leaving low-quality reserves of gravel in many areas, and that specifications for concrete aggregates have been made constantly tighter by the state highway departments. The Dravo Corp. ran tests of both heavy-media separation and the standard jigging process which showed (1) that the H.M.S. process requires a higher initial investment than jigs, (2) that operating labor costs are about identical, (3) that H.M.S. can stand extreme variations in the feed rate, (4) that jigging works most efficiently with a steady supply of water, (5) that

At the Industrial Minerals conference on Wednesday afternoon the following speakers appeared left to right: co-chairman Felix Shay, Foote Mineral Co., and J. N. Suliot, Michigan Limestone Division, U. S. Steel Corp.; William L. Price, Keystone Division, Dravo Corp.; John C. Vonderau, Michigan Limestone Division, U. S. Steel Corp.; Gershon Cooper, Dunlop & Associates, Inc.; Neil O. Johnson, Foote Mineral Co., and Russell W. Hunt, Southwest Lime Co.

Appearing on Thursday's Industrial Minerals program were, left to right, C. A. Rowland, Allis-Chalmers Manufacturing Co.; C. C. Van Zandt, Lone Star Cement Co.; session chairman C. E. Wuerpel, Marquette Cement Manufacturing Co.; Fred W. Pfau, International Salt Co.; H. A. Corre, Warner Co., and C. V. O. Hughes, Virginia-Carolina Chemical Co.

H.M.S. is more effective than the jigging process under conditions of rapid fluctuation in the percentage of deleterious material in the feed, (6) that H.M.S. can be expected to make a cleaner cut in cases where a definite specific gravity is required and (7) that the H.M.S. cost range for gravel will be in the vicinity of 15 to 20 cents per ton, while jigging would cost about 5 to 10 cents per ton. Price said that he could make one statement with assurance, "The ultimate consumer of the aggregate will stand to gain immensely by these improvements in the quality of the aggregate."

Neil O. Johnson, manager, Foote Minerals Co., was next on the program, talking on the "Kings Mountain Lithium Mining Operations." There has been a great deal of interest in this uncommon metal in recent years, although it was first produced in metal form in 1855 by Robert Bunsen, the inventor of the Bunsen Burner. Most of this country's reserves of lithium ore are centered on the Kings Mountain area in North Carolina, and of the three major lithium producers in the United States, only Foote Minerals Co. mines its ore domestically. Johnson traced the Kings Mountain operation from its earliest beginnings and the exploration of the ore body through the engineering layout of the pit and the methods and equipment used in mining the ore. Since drilling and blasting make up a considerable part of the mining cost, a great deal of testing and research have gone into developing the most efficient methods. Delay blasting is standard practice, and it has been found that it improves the fragmentation, gives better control of the throw—facilitating selective mining—and reduces ground vibrations. Secondary breakage is accomplished with a 10,000-lb dropball. Loading is with small diesel-powered shovels (1½ yd), and 10, 15, and 22-ton diesel trucks serve as haulage units. Maintenance is an important aspect of the operation, since both ore and waste are highly abrasive, and the company has made it a policy to constantly search for better maintenance methods. By centralizing repair work in a new shop building with adequate equipment and better organization, it was found that better maintenance was provided at less cost.

The last paper of the afternoon, "Utilization of Mined Out Areas" by Russell W. Hunt, president, Southwest Lime Co., stirred up an exceptional amount of interest among the underground operators who were present. He told of his research into the Government's need for underground storage in which he found that very little had been done to prepare for moving underground in case of another war. Hunt had an unusually nice situation at his property and decided to fix it up as underground storage space. He did a complete job, installing concrete division walls, fire doors, complete ventilation and sprinkler systems, a private water supply, adequate reflective lighting with painted walls, humidity control, and a double railroad dock underground, 15 box cars long with complete unloading facilities and equipment. Hunt urged all operators to consider a possible utilization of their own workings for underground storage now or in the future. He showed that in many instances it can be a highly profitable venture.

* * * *

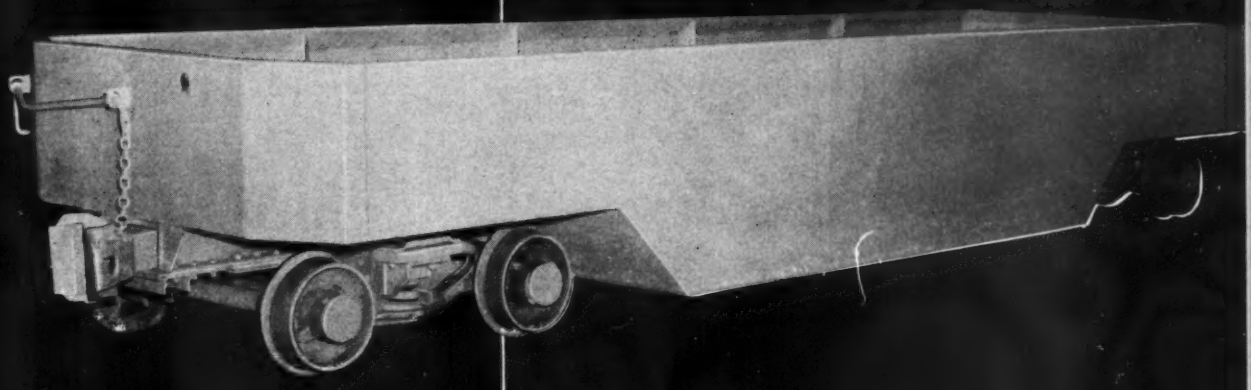
C. E. Wuerpel, vice-president, Marquette Cement Manufacturing Co., Chicago presided over the second session on Industrial Minerals on Thursday morning. The audience, composed of industrial minerals operators showed intense interest in each of the outstanding papers presented on this session.

Fred W. Pfau, maintenance superintendent, International Salt Co., Detroit, speaking on "Preventive Maintenance for Steady Operation at a Salt Mine" briefly described the mining methods and facilities for extracting salt from the company's underground mine located 1137 ft below the southwest portion of Detroit. Pfau listed all of the various items of equipment used and showed how the maintenance department was organized to service this equipment. Two shops, one underground and one on surface, are equipped with machine tools, wood-working tools, and welding equipment. They are of sufficient size to do centralized maintenance and some fabricating. Adjacent to each shop are a tool crib and supply warehouse. Inventories are controlled closely by a stock record system and issues are made only on a proper requisition which indicate the cost center where the material is to be used. About 95 percent of the work of the maintenance department is preventive maintenance controlled and planned by a job order system under two classifications: (1) Long term planned overhauls, and (2) routine maintenance. Job order cards are systematically filed in a visable tray cabinet where valuable information on every piece of equipment is conveniently available. Through its preventive maintenance system, the company has cut total down time for all equipment combined to two percent, and for critical equipment—that is preparation facilities, mainline conveyors, and hoisting and shipping facilities—to .01 percent, illustrating what can be accomplished.

"New Grinding Installation at Lone Star's Nazareth Plant" by Claiborne C. Van Zandt, vice-president, Lone Star Cement Corp. was a description of a new modern grinding plant using eight 1000 hp mills for raw and finished grinding. A modernization and expansion program at this plant is now being carried out—to be completed late this year. The capacity will be increased 1,300,000 bbl to a total annual capacity of 3,600,000 bbl. The whole system is being "beefed up," starting with the installation of a primary crushing plant in the quarry consisting of a 42-in. gyratory followed by two impactors. The expansion requires increased storage bin and raw and finish grinding capacity, and new homogenizing tanks, rotary kilns, and clinker and gypsum silos. A complete new 4160 and 440 v power distribution system is being installed and a new 75 ft by 272 ft mill building of concrete construction is being built.

H. A. "Pat" Corre, mine superintendent, The Warner Co., Bellefonte, Pa., substituting for Robert L. Smith, his mine engineer, presented an interesting talk, illustrated by slides, on "The Slope Conveyor System at Bell Mine." Long range engineering was required to assure steady production in future years from the Bell Mine. After proving reserves below the present hoisting level by drilling and exploratory development, it was decided that the best way to get at these reserves was to sink an incline

(Continued on page 129)

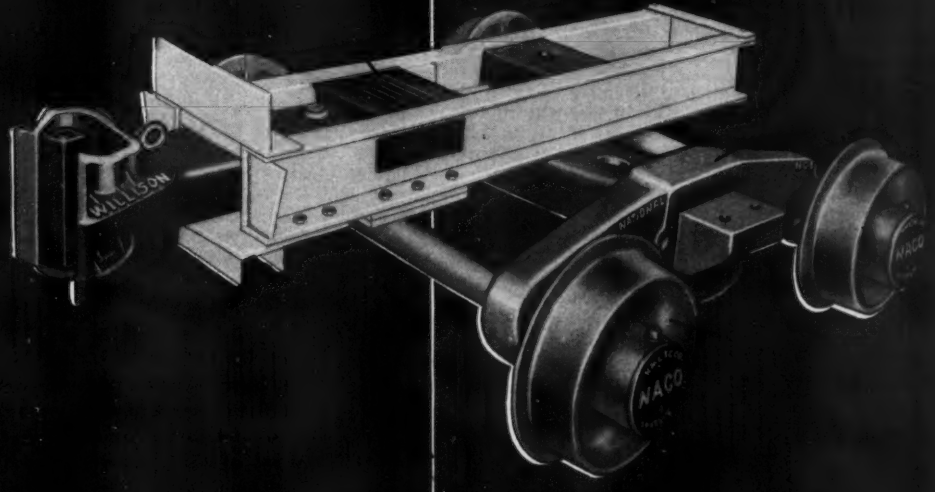


Barnes and Tucker Company continues to specify

NATIONAL

equipment for all 8-wheel mine cars

NATIONAL
CASTINGS COMPANY



The River Queen uncovers two seams of coal. Standing on the bottom seam it first removes 3 to 15 ft of parting covering that seam following mining of the top seam and then strips up to approximately 80 ft of cover from the top seam

The River Queen

Taller than a 13-story building and heavier than a Navy destroyer, a 55 cu yd shovel has gone to work in a new open pit coal mine in western Kentucky

One of the largest mobile land machines ever built in the United States, a 2400-ton power shovel named the River Queen, is being used to uncover two seams of bituminous coal in the River Queen Mine near Central City, Ky. The mine is owned jointly by the W. G. Duncan Coal Co. and Peabody Coal Co. It is operated by Peabody. With this gigantic stripping machine and with equally modern equipment for the loading and preparation of coal, the new River Queen Mine will be able to ship 2,000,000 tons of coal annually both by rail and by water over its own loading dock on nearby Green River.

Boarding-House Reach

The River Queen, a Model 1650-B special long-range stripping shovel equipped with a 55 cu yd dipper, is the largest power shovel ever built by Bucyrus-Erie Co., South Milwaukee, Wis. Capable of moving a 100,000 ton mountain of earth in 24 hours, it has a working weight of 4,800,000 lb and stands 140 ft high. It is equipped with a 145-ft boom and an 86-ft dipper handle, enabling it to dump rock and earth overburden nearly 300 ft away from the digging point and to stack the material more than 100 ft high. In each pass of its dipper, the River Queen excavates enough material to fill a room 14 by 12 by 9 ft.

More than 70 railroad cars were required to ship the shovel from Bucyrus-Erie's South Milwaukee plant to the erection site. First pieces of the shovel arrived late last summer and the River Queen took its first bite of overburden in March. Bucyrus-Erie personnel directed the erection of the shovel.

The 1650-B will excavate only down to the coal seam; actual coal loading will be done by smaller power shovels. They will load into large diesel haulers which will take the coal to a washing and screening plant now under construction. The plant will be geared to wash 1000 tons of coal per hour.

One Operator

Despite the River Queen's size, one operator controls the entire digging of the machine with two hand levers and two foot pedals. The operator's glass-enclosed cab, perched 30 ft above the ground at the right front corner of the machine, was constructed to provide maximum visibility.

The cab has an air conditioning system and an inter-communication hook-up with four telephone sets. A loudspeaker attachment on the boom enables the operator to keep in contact with his ground men and those in the pit area. Further enhancing the cab's comfort and utility are tile flooring, wood paneling, a water cooler, clothes lockers and a foreman's desk.

Statistics

Fifteen General Electric motors power the shovel—11 for digging and 4 for propelling. The main motors are two 1500 hp a-c motor-generator-set, synchronous-driving units. The main functional d-c motors consist of four hoist motors rated at 375-hp each; three swing motors at 187½-hp each; two crowd motors at 187½-hp each; and four 200-hp propel motors.

Special high-strength alloy steels are used in the shovel. The dipper is made of T-1 steel; the dipper handle and boom are of Tri-Ten steel, both made by the United States Steel Corp.

Each crawler weighs 217,700 lb, is 13 ft 5 in. wide and 26 ft 9 in. long

All connections are welded—the only rivets in the machine are used in the brake bands.

The dipper is constructed of welded alloy plate to withstand severe shocks and abrasions. It has a main door and, behind it, an auxiliary door which permits the hinge points of the main door to be placed further forward, reducing the weight on the main door latch keeper. The dipper latch is tripped by power furnished by an enclosed ball-bearing motor mounted on the dipper. The dipper is equipped with renewable tooth points.

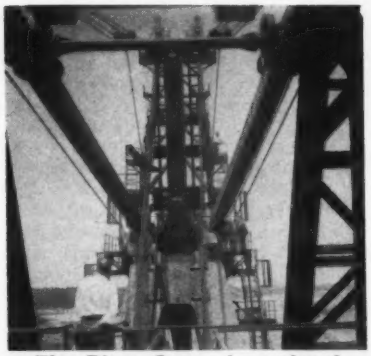
The River Queen is mounted on four independently motor-driven crawler-type trucks, each weighing 217.7 tons. Each crawler unit is 13 ft 5 in. wide, 26 ft 9 in. long and 10 ft 9 in. high. Crawler bearing area is 670 sq ft, giving a bearing pressure on the ground of 7230 lb per sq ft (50.2 psi). A ground man directs the machine's moves from an electrical control box mounted at the base of the machine.

Loads from the base of the shovel are transmitted to the trucks through hydraulic jacks located at each corner of the lower frame. The jacks keep the revolving upper frame level while operating, though the machine might be on uneven ground. Hydraulic power steering for crawler trucks enables independent slewing of front and rear trucks to align them with any bump or turn they might encounter. The two forward and two rear trucks are connected in pairs. Use of this type of crawler truck provides flexibility in maneuvering the big shovel.

The revolving frame consists of four parts—the front-end box girder, two side-box girders and the rear-end section, or ballast box. Loads on the roller circle are widely distributed. The circle has many heat-treated rollers revolving between two heat-treated alloy steel casting rail circles. Each roller is lubricated independently.

The four hoist motors each drive through a flexible coupling to their own enclosed herringbone tooth reduction gear units. Use of four reduction gears and main pinions reduces gear tooth loading and the size of individual parts. Each of the four motor-reducer units has a spring-set, air-released brake which set in case of power failure.

The hoist cable drum is operated by two helical gears, each 13 ft 2 in. in diameter. The two double single-part



The River Queen is equipped with a 145-ft boom and an 86-ft dipper handle

hoist cables are 2⅝ in. in diameter. They are lubricated by a series of jets operated by compressed air.

Swing machinery units are mounted on each side of the revolving frame. Each unit consists of a motor driving through totally-enclosed helical tooth gear reductions to the vertical rack pinion shaft. All bearings used are anti-friction, except for a bronze-bushed bearing for the rack pinion shaft. An electrically-controlled, spring-set, air released brake on each motor sets in case of power failure. Continuous lubrication is provided by a motor-driven oil pump.

Two separate crowd drums, each motor-driven through reduction gears, crowd out and retract the dripper handle. Crowd ropes are lubricated by compressed air-operated jets.

SPECIFICATIONS—THE "RIVER QUEEN"

Main Specifications

Net weight, domestic, approximate	3,950,000 lb
Working weight, approximate	4,850,000 lb
Ballast required, furnished by purchaser	900,000 lb

Working Ranges

Capacity of dipper	55 cu yd
Length of boom	145′
Effective length of handle	86′
Angle of boom	47½°
Dumping height, maximum	106′
Dumping height, maximum radius	69′
Dumping radius, at maximum height	139′ 6″
Dumping radius, maximum	147′ 6″
Dumping reach from outside edge of crawler truck, maximum	122′ 9″
Cutting radius, maximum	158′
Level floor radius	96′
Clearance radius of revolving frame, upper	43′ 6″
Clearance radius of revolving frame, at bottom	40′
Clearance under frame to ground	24′ 6″
Height boom foot pin	29′ 8″
Distance boom foot pin to center of rotation	19′ 3″

All height dimensions are with leveling jacks at mean extension.

Electrical Equipment

Motor generator set driving motors, synchronous	Two 1500-hp-0.8 P.F.
Hoist motors (Blown)	Four 375-hp-Cont. 75°C
Swing motors (Blown)	Three 187.5-hp-Cont. 75°C
Crowd motors (Blown)	Two 187.5-hp-Cont. 75°C

Generators for Ward Leonard rotating control—capacity to suit respective motors.

Crawler Truck Mounting

Width of treads	4′ 6″
Overall width of mounting	49′ 5″
Overall length of mounting	58′ 7½″
Overall width of each truck	13′ 5″
Overall length of each truck, approximate	22′ 7½″
Total effective bearing area	670 sq ft
Bearing pressure—lb per sq ft	7230
Horsepower propelling motors (1 on each truck)	200 hp
Propelling speed—normal	0.22 mph

Base

Center to center of leveling jacks	36′
Depth of girders	8′ 4″
Diameter of roller circle	38′
Number of rollers	100
Diameter of rollers—mean	12″
Pitch diameter of swing rack	28′ 9⅝″

Revolving Frame

Width and length, approximate	36′ x 61′ 8″
Depth of girders	56″

Leveling Jacks

Diameter of cylinders	32″
Length of stroke	56″

Machinery

Diameter of hoist drum	88″ P. dia
Hoist ropes—twin double	2⅝″ dia.
Diameter of boom point sheave	120″ P. dia.
Diameter of crowd drum	72″ P. dia.
Crowd ropes—twin double	2⅝″ dia.
Backhaul ropes—twin single	2⅝″ dia.
Diameter of crowd sheave	84″ P. dia.

New Conveying and Electronic Weighing System

By
MELVIN A. STOKKE
Supt. Crushing & Conveying Plant
Anaconda Reduction Works

ON May 1, 1955, The Anaconda Company at Anaconda, Mont., started operation of the East Anaconda Crushing Plant. This plant, contiguous to the marshalling yards of the B. A. & P. Railway Co., is designed to dump, crush, and convey ore to the concentrators of the Anaconda reduction department.

A modern tipple and crushing plant —which can probably be termed of conventional design—was erected. A lift, 3830 ft long, from an elevation of 5250 to 5638, equivalent to a vertical lift of 388 ft, from the crusher plant to the concentrators, in the face of extreme topographical features, and without disrupting or disturbing existing railway and plant installations, called for engineering of the highest caliber in designing the conveyor system.

This briefly then was the scheme to replace a comparatively slow-train-haul system up to an old tipple-crusher operation at Anaconda.

A general comparison of the old and the new ore handling methods at Anaconda will show quickly what has been accomplished to expedite this operation. Formerly, trains with a maximum of 27 loaded cars moved from the East Anaconda yards to the one-car rotary dumper at the concentrator. One hour and 45 minutes was required for a tortuous train run, exclusive of dumping, crushing and transferring ore to concentrator storage bins. The one-car dumper, erected in 1928, had a capacity of 270 cars per day.

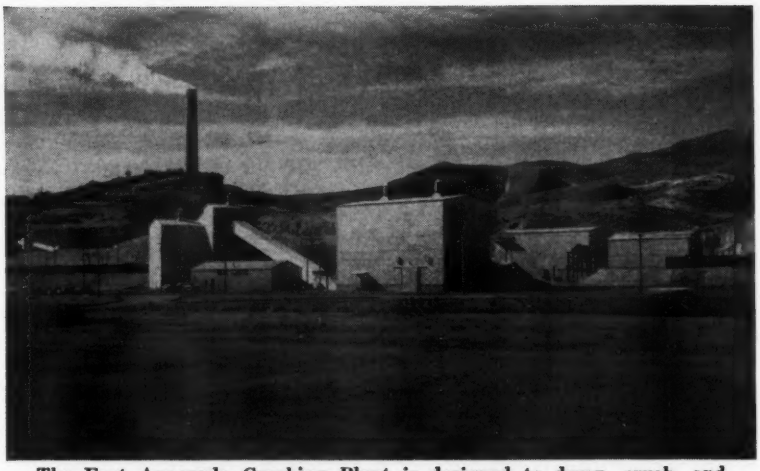
With the new facilities, the complete operation—dumping, crushing, conveying and storage in concentrator bins—on 27 cars of ore is performed in approximately 40 minutes. The new two-car rotary dumper is designed to handle upwards of 700 cars per day, which rate will be attained with the completion of additional ore storage and treatment facilities.

Communication Facilitates Handling Ore

Several types and kinds of ore comprise the trains from Butte—the site of The Anaconda Company's Montana mining operations—to Anaconda. Low-grade copper ore, regular copper ore, manganese and zinc ores can conceivably be in any ore train that arrives at the East Anaconda yards. The ore cars, upon arrival, are segregated and spotted, according to the type of material they contain, on four storage tracks leading to the tipple. A dispatcher in the tower control room at the tipple designates the type of ore to be spotted by the B. A. & P. Railway on the respective storage tracks.

Communication is a vital part of the operation. It facilitates handling and

No. 9 belt conveys crushed ore to the fine ore bins. It is 48 in. wide and 988 ft long—center to center of pulleys



The East Anaconda Crushing Plant is designed to dump, crush, and convey ore to the concentrators. The Symons crusher building is shown on the left, gyratory crusher building in center, and the tipple and engine shed on the right

New ore handling methods at Anaconda, Mont., have more than doubled the number of cars handled in a 24-hour period. Here is a first hand account of the East Anaconda Crushing Plant. The complete operation—dumping, crushing, conveying and storage in concentrator bins—is presented step by step

insures correct dispatching of the different types of ore. Three types of communication are used: radio, teletype, and private branch telephone exchange.

Radios are used by the diesel-electric locomotive engineer, the tipple operator and the switchmen at each end of the tipple.

Teletype is the method by which the traffic office at Butte advises the Anaconda dispatcher of the car numbers, and types of ore.

An isolated private branch telephone exchange links all important stations along the route of the ore stream.

Operation of the Plant

A 65-ton diesel locomotive pushes a string of cars onto a Link-Belt rotary car dumper, where two cars are spotted at a time by means of a radio communication. The car dumper then rotates thru an arc of 160° discharging the ore into two steel hoppers located directly above 60-in. apron feeders. The flow of ore from the apron feeders to the No. 1 and No. 1A belts is regulated by three speed motors. The drier ores are run at full speed, which is between 40 and 45 cars per hour. The semi-wet ores are run at a rate of 30 cars per hour, while the wet, sticky ores are run at slow speed or 20 cars per hour. There are several reasons for running the wet ores at a slower speed—to avoid choking of chutes and transfer points, and to obtain better screening in front of the secondary crushers.

The No. 1 and No. 1A belts carry the ore from the tipple building to the gyratory crusher building. Near the discharge end of the belts are located the woodpicking stations on each side of the belts for removal of wood and exposed pieces of scrap iron. The wood is put into hoppers which discharge into side-dump railroad cars spotted directly below. The scrap iron goes thru a chute into a dumpster box for removal. As the ore cascades from the No. 1 belts it passes over vibrating screens which have a maximum opening of 5½ in. The oversize material goes into a 20-in. gyratory crusher for primary grinding to 4½ in. The minus 5½-in. material joins the product from the gyratory crushers on the No. 2 and No. 2A belts.

At the discharge end of the No. 2 and No. 2A belts are located high-intensity rectangular suspended magnets. Tramp iron moving into the field of the magnet is removed from the conveyed material and held firmly to the magnet face until the magnet is removed by an overhead crane. After the direct current is shut off, the tramp iron drops into a steel boat for removal.

The ore stream coming from the No. 2 belts drops down onto the 2½ belt, which is a short conveyor designed primarily to lessen the wear on the next longer, No. 3 belt. The excessive wear is caused by a change in direction, and an increase in speed of the ore from 150 fpm to 500 fpm. The life of the wear belt has been considerably increased by the use of a shock-pad belt with a ¼ in. raised section in the center 18 in. of the belt.

The No. 3 belt conveys the ore from the gyrator crusher building to the Symons crusher building. This belt travels up an incline of 13½° and enters near the top of the crusher building for distribution to the various crushers.

Weighing Ore in Transit

Located on the No. 3 belt are two weigh carriages for weighing the ore in transit. The first has three sensing idlers that transmit the load to a pneumatic load cell. This cell, in conjunction with an A-C permanent magnet tachometer, sends a pressure and a frequency to a precision instrument for recording the weight of material passing over the belt.

The second system for weighing the flow of material in transit is the Belt-Meter. There are four major components of the Belt Meter; the carriage, the tachometer generator, the load cell, and the Electronik recorder.

The carriage is a pivoted unit which is mounted on a section of the conveyor structure between the upper and lower strands of the belt. This unit has one sensing idler through which the weight of the material on the belt is transmitted to the load cell. A counterweight, riding on an arm on the opposite side of the pivot from the sensing idler, enables the tare weight of the idler, carriage and part of the belt to be balanced out.

The tachometer is a permanent magnet type direct current generator. This generator is driven by an idler located on the clean side of the return belt and produces a d-c voltage proportional to the belt speed.

The load cell is a resistance type, strain gauge with a 500 lb capacity. This cell is a device that translates changes in weight into changes in electrical energy. The voltage from the tachometer generator is applied to the load cell, which in turn de-

velops an output voltage proportional to the product of the belt speed and weight of the material.

The voltage from the load cell is then measured by an Electronik recorder, which is specially modified and adapted for this service. The recorder contains calibrating adjustments and provides a large dial indication and a 24 hour chart record of the instantaneous rate of flow. The instrument also contains an integrator which shows the accumulated tonnage on a small counter. A remote counter is also located at the dispatcher's desk in the tipple tower. By allowing a two to three minute break after the different types of ore, the accumulated tonnage can be recorded. This accumulated tonnage is entered on a daily dump report before and after running a type of ore. The difference between the two figures is the tonnage for the number of cars dumped.

Secondary Crushing

The No. 3 belt discharges into a three-way chute, regulated by a system of gates so that the ore can be fed to any combination of one, two, or three crushers. As the ore leaves the three-way chute, it goes onto the No. 4 belts, which discharge onto 6 by 14 ft vibrating screens. The plus 1½-in. material goes into seven ft standard Symons crushers where the ore is crushed to 1 in. The minus 1½ in. from the screens joins the product from the Symons crushers on the No. 5 belts. After the secondary crushing the ore is now classified as mill feed and is ready to be conveyed to the fine ore bins.

Conveyor Housing for Series of Long Belts

The No. 6 belt collects the ore from the three No. 5 belts and conveys it to a series of long belts, namely the No. 7, No. 8, and No. 9. These belts convey the ore from the Symons crusher building to a junction house at the west end of the concentrator, a distance of 3830 ft.

The No. 7 belt leaves the crusher building through an 8 ft wide by 8 ft high concrete tunnel. Made of precast concrete sections, the conveyor tunnel passes under our storage tracks, the B. A. & P. Railroad yards, and comes up to ground level approximately 1300 ft from the tail pulley at a splice house for servicing the separate lengths of the No. 7 belt. Open excavation resulted in the removal of 120,000 cu yds. of rock to permit placing this portion of the concrete gallery underground.

From the splice house the conveyor spans across the ravine 625 ft wide with the conveyor gallery 62 ft above the floor of the ravine. This section of gallery is of steel construction with a siding of transitop and extends to the No. 1 Junction House. Here is the motor and gear reducer for the No. 7 belt. The building also houses the gravity take-ups for the No. 7 and No. 8 belts. It might be interesting to note that in order to apply the necessary tension to the 3490 ft long No. 7 belt, a counterweight of 21,000 lb was designed for the gravity take-up.

The conveyor housing for the No. 8 and No. 9 belts is of similar construction to the No. 7—part gallery, part tunnel and each has a splice house. The three long conveyors just mentioned are powered by 500-hp motors and travel at a speed of 500 fpm.

An automatic sample cutter passes through the ore stream as it discharges from the No. 9 belt. This portion of ore is conveyed to an adjoining building, the sample mill. Here the ore is screened, crushed and sampled. The rejected material from the sample mill is conveyed and elevated to be returned onto the tail end of the No. 10 belt.

The No. 10 conveyor carries the ore from the No. 3 junction house to a transfer point midway between the East and West mills. The conveyor structure inside the concentrator is carried on steel members that are suspended from the roof trusses.

The ore stream from the No. 10 belt discharges onto the No. 10A belt, which is a motor propelled reversible

The 60-in. No. 4 A belt discharging ore onto vibrating screens above Symons crushers

FLOWSHEET
EAST ANACONDA CRUSHING PLANT

Car Dumper—Link-Belt rotary car dumper—2 car revolves 160°
Pan Feeders—Link-Belt 60-in. apron feeders, 17.8 fpm, 3 speed, max 45 cars per hour.
#1 & 1A Belts—60 in. wide, 233 ft long, rise 47 ft, speed 135 fpm.
Vibrating Screens—6 by 12 ft Allis-Chalmers, max. opening 5½ in.
Gyratory Crushers—Traylor 20-in. Bulldog crushers, 4½ in. minimum opening
#2 & 2A Belts—60 in. wide, 37 ft long, speed 150 fpm
#2½ Belt—48 in. wide, 31 ft long, speed 500 fpm
#3 Belt—48 in. wide, 307 ft long, rise of 69 ft, speed 500 fpm
Three Way Chute—Can open to one, two or three chutes
#4, 4A, 4B Belts—60 in. wide, 28 ft long, speed of 150 fpm
Vibrating Screen—6 ft by 4 in. Allis-Chalmers, max. opening 1½ in.
Symons Crushers—7 ft standard cone crushers, min. opening 1 in.
#5, 5A, 5B Belts—60 in. wide, 27 ft long, speed 150 fpm
#6 Belt—60 in. wide, 74 ft long, speed 300 fpm
#7 Belt—48 in. wide, 1700 ft long, rise 115 ft, speed 500 fpm
#8 Belt—48 in. wide, 1164 ft long, rise 135 ft, speed 500 fpm
#9 Belt—48 in. wide, 988 ft long, rise 140 ft, speed 500 fpm
#10 Belt—48 in. wide, 420 ft long, rise 10 ft, speed 500 fpm
#10A Belt—Shuttle belt to discharge to East and West Mill bins, 48 in. wide, 345 ft long, speed 500 fpm
#11 Belt—48 in. wide, 217 ft long, 38 ft rise, speed 500 fpm
#12 Belt—Shuttle conveyor to discharge to zinc bins, 34 ft 6 in. long, speed 500 fpm

MELVIN A. STOKKE graduated in 1948 from Montana State College with a degree in Civil Engineering. Subsequently employed by The Anaconda Company, he has served as a draftsman, construction engineer, assistant superintendent of Conveying Plant, and superintendent of East Anaconda Crushing and Conveying Plant.

shuttle conveyor. This conveyor is carried on single flanged wheels, and has a traversing speed of 50 fpm. The ore leaving this belt goes into the fine ore bins. The circuit is now complete for the manganese and the copper ores. In order to handle the zinc ores, the No. 10A conveyor is traversed to the extreme east end of the concentrator. Here the zinc ores are discharged onto the No. 11 belt, which conveys to shuttle belt, the No. 12. The ore from the No. 12 belt goes into two fine ore bins located by the zinc crusher building.

Precautions

Starting from the fine ore bins, all conveyors are electrically interlocked with each other and with all of the equipment at the crushing plant. If any piece of equipment is shut down, then all of the equipment back to the tipple automatically shuts off. This prevents the ore from piling up on the piece of equipment that is not running.

Zero speed limit switch idlers were installed on the return strand of all conveyor belts. In case a belt is accidentally cut in half, the idler stops turning and the limit switch stops the equipment behind the ripped belt.

A system of sirens and horns was placed throughout all buildings and along the route of the conveyors. The operators, when starting up the equipment, sound the signal and then wait two minutes to allow the maintenance men time to be in the clear. The men working on or around the machinery can place locks and signs on the switches; thus the equipment cannot be started until these are removed.

The East Anaconda Crushing Plant is successfully meeting the expanded production from the Butte mines. To date, we have more than doubled the number of cars handled in a 24-hour period and are prepared to meet a future increase.

How a midwest steel producer

TRIPLED TRACTOR-SHOE LIFE

It's "tough-going" in a slag pit! Heavy loads, the grinding impact of abrasive rock and metal, really put tractor shoes to the test. And that's exactly what this steel producer did.

Amsco® cast Manganese Steel Tractor Shoes were installed in place of rolled shoes. The result: *a 3-time increase in service life.* While rolled shoes had previously been replaced after one season's service, the Amsco pads lasted nearly *3½ years—a total of 3374 service hours.*

Here's further proof that Amsco Manganese Steel—"the toughest steel known"—can save you money and replacement time wherever severe impact and abrasion are a problem. Call your nearest Amsco representative, or write us direct, for further information on Amsco Tractor Shoes.

Amsco Manganese Steel Tractor Shoes
In addition to excellent impact and abrasion resistance, Amsco Tractor Shoes have countersunk bolts. This means less wear on bolts, often saves bolt-replacement when changing pads.

AMERICAN Brake Shoe COMPANY

AMSCO

American Manganese Steel Division • Chicago Heights, Ill.

OTHER PLANTS IN: DENVER, LOS ANGELES, NEW CASTLE, DEL., OAKLAND, CAL., ST. LOUIS; JOLIETTE, QUEBEC

Wheels of GOVERNMENT

As Viewed by HARRY L. MOFFETT of the American Mining Congress

WITH over five months of the current session gone by, Congress has yet to act on any major legislative proposals except appropriations bills. In fact, out of over ten thousand measures introduced since January, less than thirty have been written into law, and these range from establishing a National Mental Health Week to providing price supports for long staple cotton. Only one bill of interest to mining has become law—this one extending the suspension of import taxes on metal scrap to June 30, 1958.

Bowing to a flood tide of mail from home, both the House and Senate continue to whack away at the President's $72 billion budget, although a large part of the cuts made to date are "paper" reductions for which funds may have to be appropriated in the future. Whether or not Congress will pass a tax reduction measure at this session remains to be seen, despite increasing talk that such action is imminent. Most observers believe that a tax slash is more likely next year when elections are in the offing. Their views are further shored up by reports that the budget surplus for this year will be smaller than anticipated.

Two changes of interest to mining have occurred in top Interior Department posts. Roger Charles Ernst of Phoenix, Arizona has been named Assistant Secretary for Land Management, succeeding Hatfield Chilson, who has been elevated to Under Secretary of Interior. Elmer F. Bennett, formerly assistant to Secretary Seaton, is now Solicitor of the Department, succeeding Reuel Armstrong, who has resigned.

Mineral Policy Developing

As this is written, it appears probable that the long-range minerals policy may be in the hands of Congress by the end of May. Its submission will culminate three years of planning and innumerable hassles among Government agencies. Constant promises to Congressional Committees during this period that the program would be submitted "soon" or at an "early date" irked legislators from mining States and brought statements from them that if the Administration did not get a program to Capitol Hill this year Congress would write its own minerals policy.

The program that emerges from the Administration, according to a number of Government officials who have had a hand in its shaping, will be a "patchwork quilt" representing compromises by the various interested Departments and agencies, many of which were zealous in their efforts to see that it does not (1) cause repercussions abroad, (2) benefit mining at the expense of consumers of minerals and metals, or (3) require heavy financial outlays to the detriment of a balanced budget. High Government officials interested in sustaining a virile domestic mining industry have made it quite clear that the industry will not be satisfied with the proposed program. They have hinted that it will contain some form of protection from foreign imports—through tariff relief and/or imposition of quotas—for those branches of the domestic mining industry which provide the major share of metals and minerals for our economy.

Submission of the program will probably touch off heated debate in Congress. Since there are only a few short weeks remaining before Congress is scheduled to adjourn, it appears that the most that will be accomplished at this session is the holding of hearings on the proposals, with more substantial action deferred to 1958.

Barter Program Revised

The Administration has taken a second look at its program of bartering surplus agricultural commodities abroad for strategic minerals and metals. Recently the Agriculture Department halted barter negotiations to see what effect the program was having on cash sales and on relations with other nations. The State Department had indicated that some friendly nations were complaining that the United States was dumping its surplus agricultural products on their potential markets. It was also reported that the Department suspended the program until it was assured that the Office of Defense Mobilization had sufficient funds to reimburse it for the strategic minerals acquired.

The Department resumed the program on May 27 on a restricted basis. Under the revised plan, surplus agricultural products will be exchanged for strategic minerals only with those foreign nations which do not have dollars with which to pay for the agricultural commodities.

When the suspension of the program was announced, the American Mining Congress urged officials of the Departments of Interior and Agriculture and the Office of Defense Mobilization to resume it promptly and to continue barter for metals until such time as an adequate long-range minerals policy is adopted. A number of Western Senators, headed by Senator Dworshak (Rep., Idaho), urged continuation of the program.

Prior to suspension of the barter plan, the Conference of Western Governors, meeting in Reno, Nevada in late April, had gone on record for its continuation pending adoption of a suitable long-range minerals program.

★ ★ ★ ★ ★ ★ ★ Washington Highlights

CONGRESS: Legislative pace slow.
MINERALS POLICY: At White House.
BARTER PROGRAM: Revised and resumed.
UNION FUNDS: Legislative curbs studied.
GAS ACT: Revision in doubt.
COAL LEASING: Increased acreage proposed.
PRICE DISCRIMINATION: House action sought.
PUBLIC LANDS: Legislation advances.
MINERAL PURCHASES: Appropriations still stymied.

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Union Funds Legislation Studied

Shocking disclosures of the Senate Select Committee on Labor-Management with respect to handling of union funds appear to be spurring action on measures to regulate union welfare and pension funds. President Eisenhower has stated that action in this field is needed, and members of both the House and Senate Labor Committees have indicated their desire to legislate on the subject during the current session.

Starting the legislative wheels turning, the Senate Labor subcommittee on Welfare and Pension Fund Legislation, headed by Senator Kennedy (Dem., Mass.), opened hearings May 27 on proposals to regulate the handling of such funds. Serious consideration is also likely to be given to some form of regulation of welfare and pension funds established voluntarily by industrial management.

Many observers feel that as hearings before the McClellan Committee continue to bring out further examples of the unbridled power of some labor leaders, there will be increasing sentiment for broad corrective legislation to curb their authority.

Meanwhile, a Senate Labor subcommittee has approved a bill which would extend the current $1 per hour minimum wage to an additional six million employes. The Administration had sought extension of this wage coverage to only some two and a half million employes of large retail and service establishments. Fate of the bill in the full Labor Committee is still in question.

Gas Act Revision in Doubt

Prospects for amendment of the Natural Gas Act at this session of Congress have dimmed considerably in the past few weeks. When hearings before the House Interstate and Foreign Commerce Committee began late last month, proponents of the Harris bill—which would ease Federal Power Commission control over natural gas producers—were jolted when ODM Director Gordon Gray, presenting the Administration's views, proposed two amendments that would have the effect of killing the measure.

Gray proposed that Congress grant the FPC authority: (1) to consider the cost yardstick, similar to that being used in public utility regulation, in reviewing sales contracts between gas producers and consumers, and (2) to review escalated prices in existing sales contracts. The Harris bill would specifically bar the FPC from considering cost of production in determining whether a price is reasonable.

Rep. Harris (Dem., Okla.) expressed disappointment over the Administration's stand and charged that it was out to defeat the measure.

Meanwhile, it has become clear that even the proponents of the bill are split on what controls over gas producers should be eased.

As a result of these factors, it appears unlikely that Natural Gas Act amendments will get very far in the present Congress.

Increased Coal Leases Sought

A drive to increase the amount of Federal public lands which may be held under coal leases in any one State has been initiated by members of the Wyoming Congressional delegation. Senators Barrett (Rep.) and O'Mahoney (Dem.) have jointly sponsored a measure which would raise the coal lease ceiling from the present 5,120 acres to 10,240 acres, with authority for the Secretary of Interior to raise this to 20,480 acres if he determines that a coal lessee needs added land to economically conduct his operations. In the House, Rep. Thomson (Rep.) has introduced a companion bill.

Sponsors of the bills are pressing for early action and express the view that the Senate bill will meet with approval of the Administration.

Another measure dealing with mineral leasing on Federal lands has taken a step forward. Senator Murray's (Dem., Mont.) bill to eliminate the present 5,120-acre limitation on phosphate leases on public lands within any one State, while retaining the overall United States limitation of 10,240 acres, has passed the Senate and been sent to the House. No action has yet been scheduled by the House Interior Committee, to which the measure was referred.

Pricing Bill Discharge Sought

Rep. Patman (Dem., Texas), chafing over the failure of the House Judiciary Committee to act on his bill, H. R. 11, which would eliminate the "good faith" defense in lowering prices to meet the equally low price of a competitor, has placed in motion a procedure which may force the bill to the House floor. He is seeking the discharge of the bill from the Judiciary Committee, a move he successfully made last year on a similar measure. To bring the bill to the floor for House debate, Patman will have to obtain the signatures of 218 members on a discharge petition.

A companion measure to the Patman bill, sponsored by Senator Kefauver (Dem., Tenn.), was subjected to extensive hearings earlier this session, but to date no action has been taken. Administration spokesmen have voiced their opposition to the bill and, should it be approved by Congress, the indications are that it might face a Presidential veto.

Lands Bills Advance

The House-approved bill to require Congressional approval of public land withdrawals for military purposes in excess of 5,000 acres was the subject of a brief hearing last month before a Senate Interior subcommittee, headed by Senator Alan Bible (Dem., Nev.). The hearing was recessed subject to call by Chairman Bible, but sentiment is so strong from within the mining industry and from other users of the public lands that chances of enactment at an early date appear bright. The measure carries a provision requiring that disposition of all minerals in military withdrawals except coal and oil in naval reserves must be made under applicable mining and mineral leasing laws, except where their disposition would be inconsistent with military use of the lands.

Another measure involving the public domain has advanced on the House side of the Capitol. Hearings have been held by the House Interior Committee on a bill which would create a National Outdoor Recreation Resources Review Commission, to study recreation resources of the public land and water areas of the United States. This Commission would make an inventory of outdoor recreation resources and opportunities and would report its findings to the President and Congress by the end of 1959. The Senate Interior Committee also held a brief hearing on a companion bill, but has scheduled no further action.

Enactment of this proposal, it is believed by some observers, would forestall action on numerous bills which have as their aim the creation of broad "wilderness areas" which would be closed to mining and other industrial activities.

Another land measure, now pending in the Senate Interior Committee, would amend the general mining laws to permit application against the annual $100-per-claim labor requirement of the cost of geophysical or geochemical surveys, exploratory drilling, or other recognized means of determining the accessibility of minerals. Senator Bible, sponsor of the measure, has stated that it is looked upon with favor by the Interior Department. No action has yet been scheduled on it.

Senate Acts on Mineral Funds

Western Senators have conducted another successful drive in the Senate to renew the Government purchasing program for domestic tungsten, asbestos, fluorspar, and columbium-tantalum. Late in May the Senate voted, over the objection of a few Eastern and Midwestern Senators, to appropriate $30 million for continuation of the minerals buying. The money is included in the third supplemental appropriations measure, which would provide funds for several Federal agencies for the remainder of the fiscal year.

The House has refused to appropri-

(Continued on page 114)

Roof Bolting at the Face Minimizes Danger of Rock Falls

When you install Bethlehem headed roof bolts at the face, using a predetermined pattern, the mine roof becomes safer, less likely to fall. This is because the roof bolts lock themselves in drilled holes, anchoring the strata into a thick, self-supporting beam.

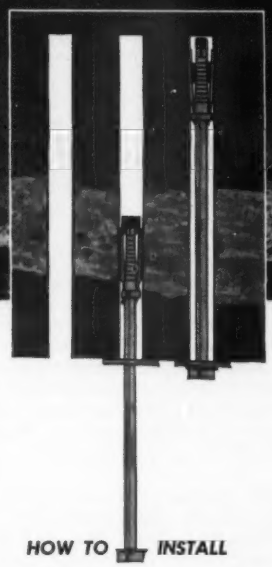
With such a roof bolting installation, wider openings and clearances are possible. And because there are no bulky supports, mechanized equipment can be maneuvered easily, even right up to the face. Besides, there's no fire hazard involved.

CHOOSE FROM THREE TYPES

The Bethlehem headed roof bolt is furnished in these types:

1. ¾-in. carbon steel; typical breaking load 24,000 lb.
2. ⅝-in. high-strength; typical breaking load 24,000 lb.
3. ⅞-in. high-strength; typical breaking load 45,000 lb.

If you would like to have additional information about the use of Bethlehem headed roof bolts, or the 1-in., wedge-type slotted roof bolt, all you need do is drop a line to the nearest Bethlehem sales office.



HOW TO INSTALL

Assembly, consisting of square-head bolt, square roof plate, malleable-iron shell and steel plug, is inserted in drilled hole.

Bolt is tightened, drawing down plug, and expanding leaves of shell.

Roof plate provides additional support. Steel tie may be used instead.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

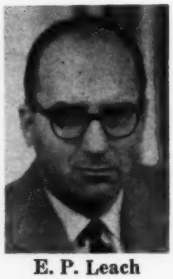
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

AMC Personals

P. B. Entrekin has been named a director of Bethlehem Steel Corp., and assistant vice-president, mining division. He has been general manager of the division since 1949. He came with Bethlehem in 1926, and served as vice-president of the company's Chile operations from 1944 to 1949.



E. P. Leach

P. B. Entrekin

E. P. Leach has been appointed general manager, mining division. He came with Bethlehem in 1941, in the company's Chile operations, where he served successively as mine superintendent, assistant manager, and from 1950 to 1954, as vice-president and manager. In 1954 he came to Bethlehem as assistant to the vice-president of the mining division.

The Warner Collieries Co., Mammoth, W. Va., has announced the appointment of **Carl A. Marshall** as vice-president—Sales. Marshall had been the managing director of the Fairmont Coal Bureau for the past 11 years.

Edwin G. Koch, head of the Montana School of Mines, Chemistry Department, has been named president of the Montana School of Mines. He succeeds **Robert Van Pelt**, who is now president of the Michigan School of Mines.

At the annual meeting of the Board of Directors, held in Chicago on April 25, **S. D. Strauss** was elected president of the American Zinc Institute. Strauss is vice-president and manager of sales, American Smelting and Refining Co.

Other officers elected were three vice-presidents: **J. D. Bradley**, The Bunker Hill Co., San Francisco; **Clarence Glass**, Anaconda Sales Co., New York City, and **H. L. Young**, American Zinc Sales Co., St. Louis. **E. V. Daveler**, American Zinc, Lead and Smelting Co., New York City, continues as treasurer and **J. L. Kimberley** was reelected executive vice-president and secretary.

At the 29th annual meeting of the Lead Industries Association, held in Chicago on May 26, **Andrew Fletcher**, president, St. Joseph Lead Co., was reelected president and chairman of the board of the association.

John R. Steelman, nationally known industrial consultant and former assistant to Presidents Truman and Eisenhower, was recently elected to the board of directors of the Glen Alden Corp., as were **Thomas Stokes** and **Frank Burnside**. The three new directors replace **Glover Johnson**, **Frank J. Manheim**, and **William W. Scranton**, resigned.

Raymond L. Larson, treasurer of Oliver Iron Mining Division, United States Steel Corp., has requested an early retirement because of illness. He concluded 45 years of service with Oliver in May. Larson had been treasurer of Oliver for the last seven years.

At a meeting of the Board of Directors of Copper Range Co. held May 1, **Robert H. Jacobson** was elected a vice-president. Jacobson is also comptroller of the company. At the same meeting, **William P. Nicholls**, vice-president and director of White Pine Copper Co., wholly-owned subsidiary, was elected vice-president of Copper Range Co.

At a meeting of the Board of Directors of White Pine Copper Co. held the same day, Jacobson was elected comptroller, and **George R. McGrath**, plant comptroller, was elected a vice-president.

St. Joseph Lead Co. has announced the following staff elections: **Norman H. Donald, Jr.**, manager of explorations; **C. DeWitt Smith**, assistant vice-president; **Robert H. Ramsey**, assistant vice-president, and **Donald K. Lourie**, secretary.

Charles M. Brinckerhoff has been elected a director of the following Anaconda Co. subsidiaries: Andes Copper Mining Co., Chile Exploration Co., and Chile Copper Co.

American Smelting & Refining Co. has a new team for its three top management jobs.

On April 24, **Kenneth C. Brownell** moved from president up to chairman of the board of directors. **R. Worth Vaughan** became president, and **Oscar S. Straus** was elected chairman of the finance committee. Retiring were **Roger W. Straus**, board chairman, who will remain as a director; and **John C. Emison**, finance committee chairman.

K. C. Brownell

Two new management directors and a new company vice-president were also elected. **R. D. Bradford**, vice-president, and **Forrest G. Hamrick**, who has also been made treasurer, were made directors. **Kershaw Harms** was elected vice-president.

R. W. Vaughan

O. S. Straus

Brownell came with ASARCO in 1927, rising to vice-president in charge of sales and then executive vice-president in 1947. In 1949 he was named president.

Vaughan joined the company in 1937 as assistant general counsel. Ten years later he was appointed vice-president and general counsel and in 1948 he was elected a director. He was made executive vice-president in 1955.

Straus came with American Smelting and Refining in 1946 and was elected vice-president and treasurer in 1955.

Bradford is president of ASARCO's subsidiary, Lake Asbestos of Quebec, Ltd.; and vice-president of the parent company. Hamrick has been an assistant to the chairman of the finance committee since 1949. Harms started his career with the company 40 years ago as a laborer at the company's Utah smelter. In 1954 he was made general manager of ASARCO's Federated Metals Division.

Obituaries

Philip D. Wilson, consulting mining engineer and geologist, was recently elected a vice-president of Callahan Zinc-Lead Co. During the latter part of World War II, Wilson was vice-chairman of the War Production Board for metals and minerals.

At the same time, **Leo Model** and **Sam Harris** were elected to the board of directors of the company.

Donald Markle, Jr., was recently elected a vice-president of the Jeddo-Highland Coal Co., Jeddo, Pa.

George C. Heikes has joined Continental Uranium, Inc., as manager of mineral resources, a new staff position created as part of the company's program to expand mining activities.

Heikes was formerly chief mining engineer for the National Lead Co. During World War II, he served as director of the Zinc Division and, later, the Aluminum-Magnesium Division of the War Production Board.

C. Ward Padgett, former general superintendent, Southern Illinois Division, Bell & Zoller Coal Mining Co., has been named superintendent of the entire Illinois Division, to comprise Ziegler No. 3, Buckhorn and Murdock mines. Padgett has been with Bell & Zoller since 1948.

Directors of Mesabi Iron Co. have elected **Erle V. Daveler,** chairman, and **Richard C. Klugescheid,** president. Both men were directors.

Daveler was president of Mesabi and Klugescheid was formerly vice-president and general counsel of Kennecott Copper Corp.

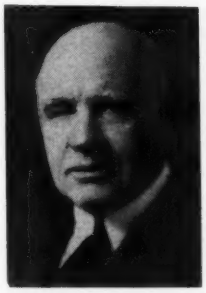
Arnold Hoffman, a director of Mesabi, was elected vice-president.

T. A. Bedford, Kaiser Engineers' Development Division vice-president, has announced that **A. A. Wallach,** copper mining and ore processing specialist, joined the company as one of the division's principal engineers. In his new position, Wallach will be responsible for project analysis in the fields of mining and quarrying, rock products, ore processing and non-ferrous metals, a part of the division's development activities.

During the two years before joining Kaiser Engineers, Wallach was chief metallurgist for the San Manuel Copper Corp. Earlier, he was with the Magma Copper Co., where, as chief metallurgist, he first worked on the San Manuel Development.

Cornelius F. Kelley, 82, former chairman of the board and president, The Anaconda Co., died May 12, following an operation in New York. At his death, Mr. Kelley was chairman of The Anaconda Company's executive committee.

Mr. Kelley was born in Mineral Hill, Nev., on February 10, 1875. At the age of 17 he embarked on his mining career as a member of a surveying team. Later he entered the University of Michigan Law School and then practiced law in Butte, Mont. In 1901 he joined the Legal Department of the Anaconda Co. and in 1908 became its general counsel. He was named vice-president and director in 1911 and served as president and director from 1918 until 1940. He served as chairman of the board for the company from 1940 until June 1955 when he was made chairman of the executive committee. Mr. Kelley was also a director of numerous mining and other companies affiliated with Anaconda.



Under the direction of Mr. Kelley, Anaconda grew from what was primarily a copper producer to the largest non-ferrous mining and metal fabricating organization in the world. The company has expanded to the point that it now has 20 mineral products and operates mines and metallurgical plants throughout the West and in three foreign countries.

Many mining honors were bestowed upon Mr. Kelley during his career, among them being the gold medal of the Mining and Metallurgical Society of America which he received in 1929 and the Charles F. Rand Memorial Medal of the American Institute of Mining and Metallurgical Engineers which was bestowed upon him in 1944.

E. L. Jarroll, president of Line Creek Coal Co. and vice-president of the Grey Eagle Coal Co., died April 7 in Charleston, W. Va., at the age of 63.

Robert M. Fryberger, 49, partner in the iron mining firm of Rhude & Fryberger, was killed in an auto-bus collision April 10, south of Virginia, Minn.

S. G. Collins, chief accountant for the West Kentucky Coal Co., died April 21. Collins had been with West Kentucky for 35 years.

Allen French, 91-year-old manager of the St. Louis Rocky Mountain & Pacific Co. at Raton, N. M., died April 17.

Mr. French had been connected with the coal company for 50 years. A native of Scotland, he worked in the coal mines of Colorado before moving to New Mexico in 1903 to become general manager of the Phelps Dodge Co. mines at Dawson.

Harry W. Byrne, 70, well-known Iron range figure, died April 14 at Ironwood, Mich. Mr. Byrne joined the Oliver Iron Mining Co. at its Gogebic range underground mine in 1909. He advanced steadily, attaining the position of general superintendent, a post he held until his retirement.

E. J. Gibson, 69, a well-known Northwest mining broker, died in Reno, Nev., May 2, of an apparent heart attack. Mr. Gibson opened a mining brokerage office in Spokane in 1925 and his firm underwrote securities of many mining companies in North Idaho's Coeur d'Alene district.

Sam Henry Buckey, 82, Utah mining figure, died April 13 at his home in Provo. Well known in State mining circles for his numerous leases of gold and silver properties around Knightsville, he was credited with the first shipment of zinc ore from the May Day mine in Eureka. He was responsible for the forming of Mercury-Dome Mining Co. in Eureka and had been active in many various mining positions until his retirement in 1946.

Allan E. Craig, The Mine and Smelter Supply Co., Denver, passed away April 7 following a short illness. Mr. Craig was a native of Denver and a 1915 graduate of the Colorado School of Mines. For six years he was mill foreman for the Timber Butte Mining Company at Butte, Montana.

During Mr. Craig's 35 years with Mine & Smelter he achieved the position of chief service engineer and assistant manager of the Marcy Mill Division. He was well known throughout the mining industry for his work in the ore grinding and gravity concentration fields.

IT'S HERE...THE "Twin Head" AUGER FOR THIN SEAMS...A NEW, EXCLUSIVE Compton of Clarksburg FIRST

FEATURES and SPECIFICATIONS

- Length: 29 feet
- Weight: 26 tons
- Augers: Carries 24—12½ ft. sections
- Power: 1—175 HP and 1—100 HP diesel engines
- Hydraulic Frame Jack Lift: 54 inch
- Auger Diameter: Two heads 24" to 32" each
- Drilling Depth: 150 feet
- Drills within 4¾" of the bottom for maximum recovery.
- Auger sections are racked conveniently on the frame.
- Elevating conveyor is integral part of machine.
- Hydraulic jack legs (with self-leveling pontoons) permit drilling up to 150 feet without misalignment.
- Double vertical overlapping holes can be drilled for greater recovery. Moves easily along working face of highwall.

Here's the new look in augers—the Compton "TWIN HEAD"—it makes thin seam mining feasible and profitable for the first time! Shoulder to shoulder the "TWIN HEAD" cuts, bores and spews forth high hourly tonnage from seams so thin they were once not suitable, nor profitable, for mining with the single headed coal augers.

Write, or call, to have a Compton sales engineer stop around and give you all the facts concerning the new "TWIN HEAD" or one of its "big brothers."

Compton, Inc.
ORIGINATORS OF COMPTON LUMP RECOVERY HEADS
CLARKSBURG, W. VA.

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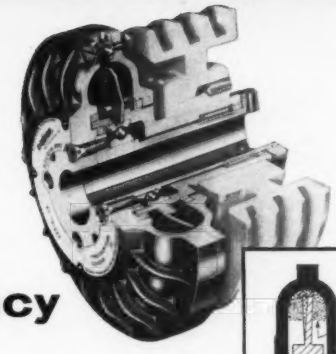
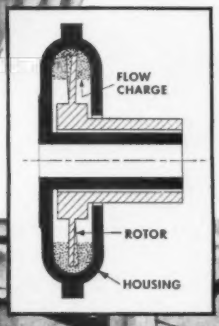
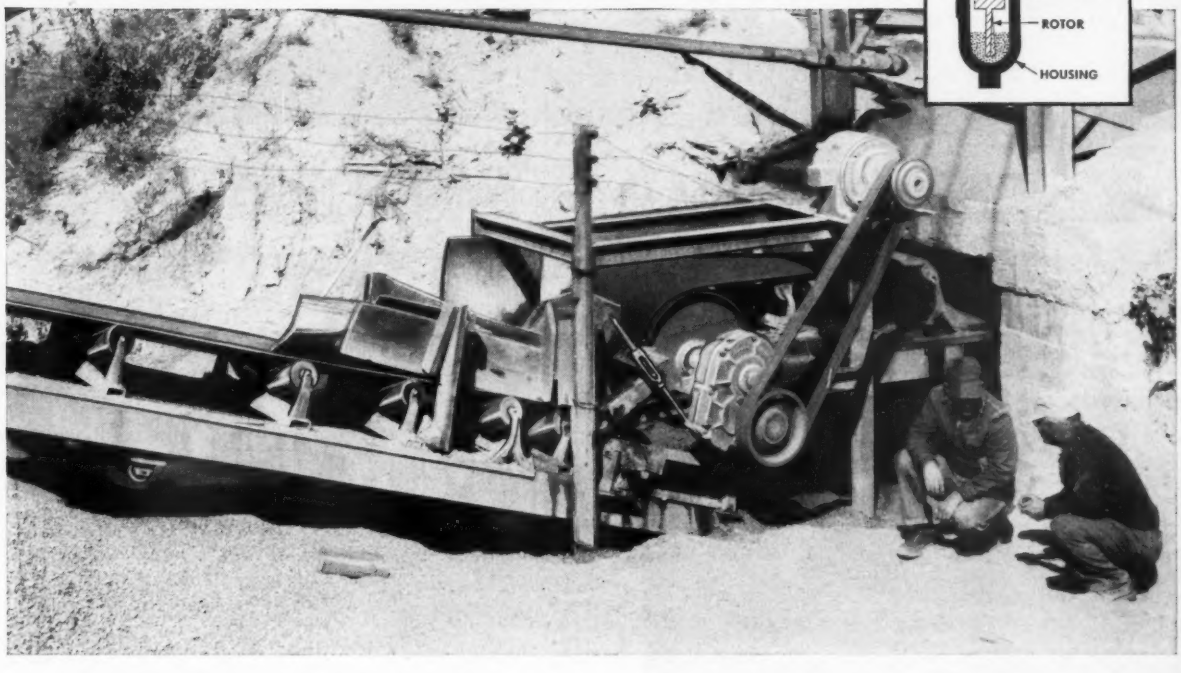
LOOK TO COMPTON

This new drive starts loads smoothly... with smaller motors ...and gives 100% efficiency at full load!







FLEXIDYNE

THE DRY FLUID DRIVE

This tunnel conveyor, 225 feet long, handles 500 tons of sand and gravel per hour—8 to 16 hours a day.

With Flexidyne, the motor picks up the load easily and smoothly. Power investment is reduced, power costs cut, maintenance simplified and conveyor belts are protected against breakage.

Flexidyne, the Dry Fluid Drive, is the *new* development that starts loads smoothly, that protects against shocks and overloads, that saves power and that gives 100% efficiency at full load!

The "dry fluid" in Flexidyne is heat treated steel shot. A measured amount, called the flow charge, is contained in the housing, which is keyed to the motor shaft. When the motor is started, centrifugal force throws the flow charge to the perimeter of the housing, wedging it between the housing and the rotor which transmits power to the load.

After a momentary slip between housing and rotor, the two become locked together and achieve full load speed without slip and at 100% efficiency during the running cycle. Changes in weather—hot or cold—inside or out—do not affect operation of Flexidyne.

Flexidyne is now available in 8 sizes—for use with electric motors and internal combustion engines from 1 hp to 300 hp. While each size is power rated, the flow charge can be varied at will to give tailor-made torque for your particular job. Write for Bulletin A-640.

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CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in in your classified phone book, or write us.

DODGE
of Mishawaka, Ind.

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WHY SETTLE FOR LESS, WHEN ANACONDA 50% GROUNDING WIRE INSURES

Greater electrical protection at no extra cost

New flat stranding of grounding conductor prevents broken wires — assures continuity of operation. Full 50% wire delivers peak electrical protection.

It takes a full 50% grounding wire to give you needed electrical protection. Anaconda's service-proven, *flat* grounding wire provides this protection, yet, because of its unique construction, allows more cable on reel. Flat 50% wire, too, offers extra safeguard . . . will not cut insulation if cable is crushed by runovers.

Millions of feet of Anaconda Securityflex* Shuttle Car Cable have been sold without a reported failure of grounding conductor. In addition, Securityflex offers . . .

3 NEW ADVANTAGES

1. Rugged high-grade *neoprene insulation* that greatly increases resistance to puncture, flame and crushing.
2. Improved stranding of ground and power conductors that prevents broken wires — assures continuity of ground.
3. Nylon breaker strip that increases short-circuit protection . . . and nylon jacket reinforcement that adds to cable strength and prevents wicking of moisture.

Insist on full-size grounding conductor for safety — insist on *Anaconda* Shuttle Car Cable. At *regular* prices. See the Man from Anaconda or your distributor. Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y. 57329

*Reg. U.S. Pat. Off.

ASK YOUR ANACONDA® DISTRIBUTOR FOR MINE CABLE

UCC to Build New Plant

Plans for the construction of a chromium and manganese ore preparation plant at Warwick, Va., were announced recently by the Union Carbide & Carbon Co. with initial construction work to start this fall. The plant will process ores from various parts of the world and will be operated by Union Carbide Ore Co., a division of Union Carbide & Carbon Corp.

It is estimated that the plant will grade and classify approximately 30,000 tons of ore a month. The ore will be shipped from Warwick to plants of Electro Metallurgical Co., another division of the corporation. Unloading facilities at the Warwick plant will operate at a rate of about 500 tons per hour, according to company officials.

In addition to the ore processing plant, the company also plans to build an office building and laboratory.

Coal Firm Sold

John E. Bowman, president of the Big Sandy-Elkhorn Coal Co., announced recently the sale of his interest in the company to Cincinnati purchasers and his planned retirement from the mining industry. The company's mines are located in Pike County, Ky.

Bowman had been president of the company since 1950 and owned 82 percent of the company stock. In resigning as president, he said new officers and directors of the company will be elected and that there would be no change in personnel.

The company, third largest in the Big Sandy area, produced more than 1,000,000 tons of coal in 1945 and is expected to produce about 350,000 tons this year.

Lithium Plant Supplies AEC

The Foote Mineral Co., Kings Mountain, N. C., recently announced a five-year contract to supply the Atomic Energy Commission with lithium hydroxide. Quantity being furnished and the uses are classified information.

According to company officials, the AEC is primarily interested in lithium-six isotopes and as these isotopes are extracted from the material the remainder is returned to the company for industrial use.

It is reported that three major lithium producers are supplying virgin lithium hydroxide to the Commission.

Jersey Zinc Buys Land

The New Jersey Zinc Co. recently announced the purchase of 16 acres of land and the leasing of another 150 acres in Clairborne County, Tenn. The company has been prospecting in East Tennessee for several years.

Anaconda Leases in Canada

The Anaconda Company recently announced that its Canadian subsidiary has obtained substantial acreage containing zinc, lead and silver mineralization with subordinate copper in the Bathurst District of New Brunswick. The announcement was made in the company's annual report.

It was also reported that The Anaconda Company (Canada) Ltd. has under option a large acreage in Northwestern Ontario, near Nakina, containing substantial tonnages of low-grade iron ore. Preliminary tests have indicated that this may be used for the production of high-grade iron nodules suitable for blast furnace feed.

E. J. LONGYEAR COMPANY
Geological and Mining Consultants
MINERAL EXPLORATION AND APPRAISALS
PHOTOGEOLOGY

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Graybar Bldg.	N. Y. 17, N. Y.
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Foreign and Domestic Mining Reports
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Pittsburgh, Penna.

(Continued from page 106)

ate any money for the minerals purchase program and was successful in getting its way in a previous supplemental funds bill. The House maintained its position in passing the current bill and again refused funds for buying the four minerals. The bill is now in conference, where it is expected that House conferees will continue their adamant stand.

Now pending before the Senate Appropriations Committee is the regular Interior Department funds bill for the next fiscal year. The House failed to include any money in this measure for the purchase programs as had been sought by the Administration. The Senate Committee may hold the Interior bill in Committee pending the outcome of the conferees' action on the third supplemental measure, and if the conferees fail to include money for the minerals purchase plan, then the Interior bill may be amended to include such funds.

Germans Investigate Ungava

Four West German industrialists have formed a mutually-owned company for exploration of iron ore deposits near Ungava Bay on the Labrador peninsula, it was announced recently.

Experts advise that the iron ore is close to the surface and can be strip mined. The four German steel producers who are interested in the Ungava property are Gutehoffnungshuette, Hoesch, Krupp and Mannesman.

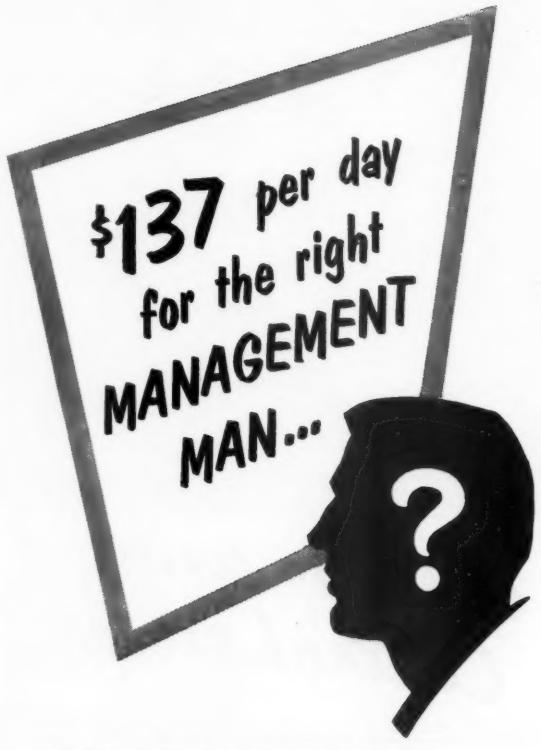
Mine Drainage Project Approved

A drainage project designed to protect millions of tons of anthracite from flooding has been approved for the Minersville, Pa., area recently, according to Assistant Secretary of the Interior Felix E. Wormser.

It is expected that the project will cost approximately $70,000 and is the tenth submitted by the Commonwealth of Pennsylvania under the State-Federal program for relief of mine-flooding problems in the anthracite region. The costs of the program are shared equally.

Site of the project is an area overlying the Reading Anthracite Company's Pine Knot Mine in the southern anthracite field. The mine is threatened by water seeping into it through abandoned stripping pits on the surface. Over 1300 ft of reinforced concrete flume and pipe will deflect surface water away from open stripping pits and carry it into a natural stream or into a self-draining underground pool in an abandoned mine.

"NEW DRILL LUBRICANT, MY EYE... I KNOW BOURBON WHEN I SMELL IT!"



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$137 per day is a big saving. . . . but possible. You can save your company AT LEAST $50,000 per year with OSMOSE PRESSURE TREATED TIES and TIMBERS.

OSMOSE Ties and Timbers resist rot that annually robs you of a fortune. Timbers are expensive but compared to REPLACEMENT LABOR today their cost is trifling.

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Leading mining companies substantiate our own enthusiasm. Pocahontas Fuel Company, Inc. says: "Our Company has been using Osmose Timber Treatment at various mines since 1942. We feel that sufficient time has now elapsed to prove the worth of your Treatment, and are pleased to advise that it has been very satisfactory to us."

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Companies Join in Exploration

The American Zinc, Lead & Smelting Co. of St. Louis and the Granite City Steel Co. of Granite City, Ill. have entered into a joint venture agreement for exploration of ore fields within the State of Missouri, it was announced recently.

In making the announcement, Howard I. Young, president of American Zinc, and John N. Marshall, chairman of Granite City, said the agreement contemplates the development of mining properties for the use of both companies in the event commercial ores are discovered. The expenses of exploration and development will be shared by the two companies. The operation of any properties developed will be handled by American Zinc.

Granite City operates blast furnaces, open hearth furnaces, rolling mills, tinplating, galvanizing and other finishing facilities while American Zinc operates mines in the States of Tennessee, Washington, Oklahoma, Arizona and Wisconsin and zinc smelters and other plants in Illinois, Ohio, Arkansas and Texas.

Zirconium Operations Begin

Operations of its new Zirconium plant at Washington, Wood County, W. Va., were started recently by Carborundum Metals Co. with zircon sands from Florida being used for basic raw materials. The plant will produce zirconium sponge metal.

The plant will employ about 175 persons by the end of the year with a long-range goal of 250. Currently, 40 persons are on the payroll.

The Carborundum Corp. has a contract with the Atomic Energy Commission to supply zirconium.

Mine Improvements Noted

An improvement program designed to increase production by 2,750,000 tons a year has been started by Eastern Gas & Fuel Associates at their Federal No. 1 coal mine near Grant Town, W. Va.

A new shaft is being driven 267 ft to the working level of the Pittsburgh seam of coal and will be driven another 60 ft below the seam to accommodate a new skip-hoisting system. The new skip-hoist system will replace the present self-dumping cages.

The company also plans installation of head frames and coal conveyors to the screen and cleaning plant facilities now located in the mine tipple.

Ore Boat Lengthened

The maiden trip of the "Cliffs Victory," which was recently lengthened to make it the longest ore carrier on the Great Lakes, was completed as the boat arrived at Superior, Wis., to pick up its first load of Minnesota iron ore for the season. The ship is owned by the Cleveland-Cliffs Iron Co.

Originally built in 1945 as an ocean freight ship, it was bought by Cleveland-Cliffs in the fall of 1951. At that time the Bethlehem Shipbuilding Co. lengthened the ship by cutting it in two and inserting a 165-ft addition. In November 1956, the boat again went into drydock, was cut in two and a 96-ft section was inserted. This made the ore carrier 716.3 ft long. The vessel will carry about 16,000 tons of ore under present loading limitations.

New Arctic Ore Plant

Work was recently completed and operations started on a huge ore-dressing plant in the Swedish Arctic ore fields at Kiruna. When at capacity, the plant will have eight pairs of magnetic dressing sections—each pair having a capacity of 500 tph.

The plant was constructed by Swedish building and engineering firms in collaboration with the Grangesberg mining companies. The total cost of the project has been estimated at over $10,000,000.

Efficient Mineral Separations with Negligible Man-Hour Cost

The SuperDuty® DIAGONAL-DECK® Concentrating table operates virtually without attention. One man supervises as many tables as he can see. Forty or more tables in battery are easily checked, but whether the installation is large or confined to one or two tables, only minimum inspection is required . . . and identical efficiency per unit is readily obtainable.

For highest grade concentrates at low cost, with negligible loss to the tailings, and a reduced volume of middlings for recirculation, always specify the SuperDuty DIAGONAL-DECK concentrating table. For full information, send for Bulletin 118-B.

CONCENCO®
Type "CPC" Classifier

This all-steel Constriction Plate Classifier is available in 1 to 10 or more cells. Novel secondary classification sharpens the separaitons made by each main cell. Advantages offered are: (1) accurate classification or sharp sizing, (2) easy and effective hydraulic water regulation, (3) as many spigot products as there are cells, (4) continuous discharge, (5) no moving parts, (6) low maintenance cost.

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COMPANY

CONCENCO PRODUCTS

★ *The ORIGINAL Deister Company* ★ *Inc. 1906*

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New Shell Rock Mine

Operations began recently on a $500,000 shell rock mining project near New Bern, N. C., by the Nello L. Terr Construction Co. The materials will be used in highway and building construction.

It is expected that the company will employ two shifts of 35 men each, and company officials expect to mine about 500,000 tons during the first year of operations. It is believed that the mine will last from 20 to 25 years and will provide a weekly payroll of between $7500 and $10,000.

Aconic Mines Expand

The Aconic Mines Corp., located along the North shore of the St. Lawrence river, announced recently that additional iron ore concentrating equipment will be added to their plant in the near future. The additional equipment is expected to boost the capacity of the plant from 220 tons per hour to 700 tons per hour.

The additional equipment is expected to cost $1,500,000 and will be installed by the German firm of Klockner-Humboldt-Deutz with which Aconic has an operating agreement.

WANTED

Rare Earth Ores

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MICHIGAN CHEMICAL CORPORATION
Rare Earths Division. Saint Louis, Michigan

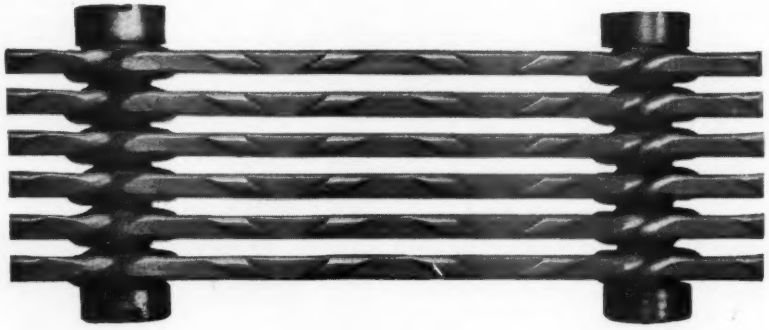
It is expected that more than 100,000 tons of magnetite iron ore with an average of 65 percent iron content will be recovered this summer.

Cobalt Co. Shifts to Silver

The Cobalt Consolidated Mining Corp., Ltd. has completed its contractual requirements for producing cobalt for the United States and will now direct its attention to silver mining, according to an announcement made recently by company officials.

The cobalt was purchased by the American Government for defense purposes and stockpiled by the General Services Administration. In the past three years, the company has shipped 1,796,198 lb of cobalt with an estimated gross value of $2,500,000 plus silver, nickel and copper with an additional gross value of $2,600,000.

HENDRICK CUTS THE CAKE!



HENDRICK WEDGE WIRE with its Riffle Top markings form an uneven screen surface to keep materials from "caking" . . . permit a freer flowing of water. Riffles are strategically spaced to guide fluids toward screen openings and assure faster dewatering. That's not all! The exposed Riffle height lifts oversize particles above the opening level . . . greatly reduces wear caused by abrasion. Hendrick Wedge Wire is also available with flat top, conical top and square top profiles bars. Write to Hendrick for more details, today.

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Famous Educators Lecture at Minnesota School of Mines

Professor E. L. J. Potts, Milburn Chair of Mining at the University of Durham, England, and world authority on strata control and rock mechanics, lectured during April and May at the School of Mines and Metallurgy, University of Minnesota. Prof. Potts is a consultant to the National Coal Board of England, the Kolar Gold Mines of India, and the mining companies of the Rand in Africa.

Prof. Otto Rellensmann, dean of the Mining Academy at Clausthal, Germany, also served as a special lecturer during the period of April 28 to May 5 on the subjects of "Mine Subsidence" and the "Gyroscope in Mining." A well-known geophysicist, Prof. Rellensmann introduced the first portable seismograph on the Gulf Coast in 1923 and has now developed a "Meridian Indicator" which employs a gyroscope to transfer the meridian underground with great accuracy.

Germany Imports Coal

West Germany consumed nearly 25 percent of all coal exported to Europe by American mining companies during the past year, according to figures compiled recently by the Coal Exporters Association of the United States. Of the 41,000,000 tons of coal exported to Europe, during this period, West Germany was the recipient of nearly 10,000,000.

Canada was the United States' best single customer for soft coal with purchases amounting to 20,652,419 tons out of a total of 68,544,323 tons exported. Among major European purchasers were Italy with 7,556,640 tons; France, 6,600,000 tons; the Netherlands, 6,583,000 tons; United Kingdom, 2,754,117 tons; Belgium and Luxembourg, 1,858,989 tons and Austria, 1,353,150 tons.

Other large purchasers were Argentina with 1,512,000 tons and Japan which purchased 3,178,329 tons.

Direct Reduction of Iron Ore

Republic Steel Corp. and National Lead Co. have announced formation of a jointly owned company R-N Corp., to exploit a direct reduction process for the treatment of both low-grade and high-grade iron ore.

The new process, which was originally devised by National Lead, will provide the steel industry with high metallic iron feed materials for use in blast furnaces, electric, open hearth and cupola furnaces, they said. The high-grade products are prepared in briquettes weighing from 5 to 25 lb while the blast furnace grades are produced as "peached seed" briquettes.

A pilot plant, constructed in 1954 at Republic's Spaulding mine near Birmingham, Ala., has been producing high metallic iron stock in quantities sufficient for commercial testing purposes.

Principal advantages of the R-N process are said to be: It treats a wide range of both non-magnetic and magnetic iron ores, yielding high metallic iron content products of uniform composition low in impurities; readily available, solid carbonaceous fuels may be used, regardless of coking properties and sulphur content, and phosphorous contained in the original ore is largely rejected.

Uranium Found in Ohio

Two Lorain, Ohio, prospectors reported recently the discovery of what they believe to be a large deposit of low-grade uranium ore on private property at the west end of Lorain County, which is on Lake Erie. The prospectors are John F. Rogers and Lewis N. Halitzka. Halitzka said the geiger counter registered four or five times the background count and that the deposit lies in Black Huron shale.

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type 6F AERODYNE® fans

For light and medium-duty mine ventilation up to 5" W.G. pressure, Jeffrey offers this new fan. It combines low cost with high efficiency, and includes the fine engineering features of all Aerodyne fans, first introduced by Jeffrey in 1936.

Proper coursing of air through a mine, or in an industrial plant, is a problem that can be answered only by experience and scientific knowledge. Jeffrey ventilating engineers can draw upon forty-six years of such experience to assist you in selecting the type and size of fans and blowers best suited to your requirements.

Catalog 901 describing this equipment will be sent upon request to The Jeffrey Manufacturing Company, Columbus 16, Ohio.

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Iron Ore Imports Up

A new high of imports of iron ore into the United States was reached during 1956, according to figures compiled by the Department of Commerce. A total of 34,000,000 tons were imported in 1956, compared with 26,000,000 in 1955 and 17,500,000 in 1954.

Nearly half of the 1956 imports came from Canada which provided 15,500,000 tons. Other major exporters to the United States were Brazil with 10,500,000 tons, Peru with 2,000,000 tons and Chile and Liberia with about 1,500,000 tons.

Other figures showed that Canada was the best foreign customer of American steel mills taking nearly 39 percent of American exports. This was estimated at about 4,000,000 tons. Imports of steel mill products reached 1,333,000 tons, the highest amount since 1953.

Reopen North Carolina Copper Mine

Ore Knob copper mine in Ashe County, N. C. has recently been reopened by Appalachian Sulphides, Inc. The mine has been worked off and on since about 1855, but the present plans are on a greater scale than any carried out previously.

The ore will be removed from a vein which ranges from 4 to 56 ft in thickness. Present plans call for the ore to be shipped to a smelter in Long Island, N. Y.

British Salvage Chrome Ore

Nearly $168,000 in chrome ore, currently lying on the ocean bed ten miles off South Africa's Cape Agulhas, is being salvaged by a British salvage steamer. The ore is being retrieved from the wreck of an American steamer which sank after a collision with a tanker during a wartime blackout 14 years ago.

Manganese Found in Antarctica

A rare form of manganese known as tephroite has been discovered on Clark Peninsula of Wilwes Land in Antartica, according to a recent story in *New York Times*. So far as can be determined this is the first discovery of high-grade ore from that continent.

According to reports, tephroite has been discovered in only three other places: Franklin, N. J., Vermland, Sweden and in the French Pyrenees and is usually found in conjunction with other extensive and valuable mineral deposits. In these three areas, however, the ore has not been found in sufficient quantities to justify mining.

It was also reported that copper stain was visible in the area where the specimens of tephroite were found.

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U. S. Steel Shifts Mine Operations

The closing of one coal mine and the opening of another was announced recently by United States Steel Co. The closing of the Palmer Mine in Frick District will be completed June 28 while the new mine will be opened this fall. Both mines are located in Pennsylvania. The new operation, the Maple Creek Mine, is located in New Eagle Borough of Washington County.

The Maple Creek Mine will be used to replace the tonnage losses that will occur due to the depletion of reserves of mines currently in operation. Annual production is expected to be 500,000 tons by the end of 1959. Current plans call for the installation of a personnel service shaft, refuse shaft, harbor facilities for barge loading, surface shop installations and a rock slope for handling supplies and equipment.

The Palmer Mine was opened in 1908 and has produced over 16,000,000 tons of high-grade metallurgical coal. In 1918 the Palmer Dock and Harbor was constructed on the Monongahela River and mines contiguous to the Palmer Mine were connected with it underground. The combined output of these mines was transported underground to the dock for barge shipment to the Clairton Works.

Radorock to Operate Claims

Radorock Resources, Inc., Salt Lake City, Utah, has entered into an agreement with Gas Hills Uranium Co. whereby Radorock will operate more than 500 uranium claims controlled by Gas Hills in Wyoming. The two companies will share in profits from the properties.

Announcement of the agreement was made by Ralph W. Neyman, president of Radorock, and Cotter Ferguson, president of Gas Hills. The properties involved are in the Gas Hills and Crooks Gap areas of Wyoming, principally in Fremont and Natrona Counties southeast of Riverton.

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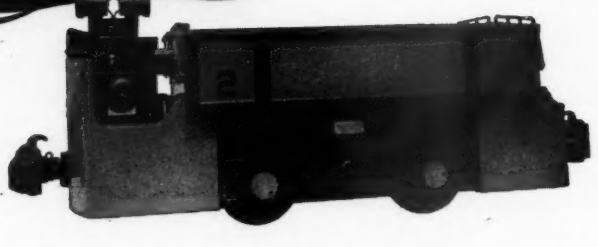

The Greensburg 8 ton Monitor is equipped with two glass insulated motors, contactor type controller and double equalizers. These double equalizers make the difference in performance . . . more tractive effort, better brakes, better riding qualities and longer battery life than any other storage battery locomotive of equal weight and battery capacity!

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Ore Reserves Investigated

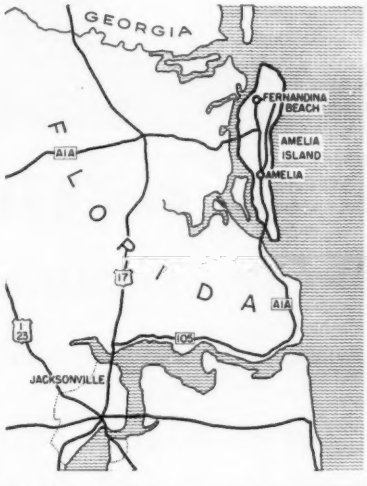
The Dominion Wabana Ore Co., with operations near Bell Island, Newfoundland, estimated recently an iron ore reserve of 100,000,000 tons in the underwater Bell Island mines. H. P. Dickey, general manager and vice-president of the company, estimates this would be sufficient ore to keep the mines going for 30 years at a current rate of production of about 12,000 tons daily.

Although investigations have not been completed, it is expected that they will be completed by the end of 1957.

Union Carbide to Mine Titanium

Mining of titanium minerals next spring (1958) on Amelia Island, on the east coast of Florida, is being planned by Union Carbide and Carbon Corp. The announcement was made by Morse G. Dial, president.

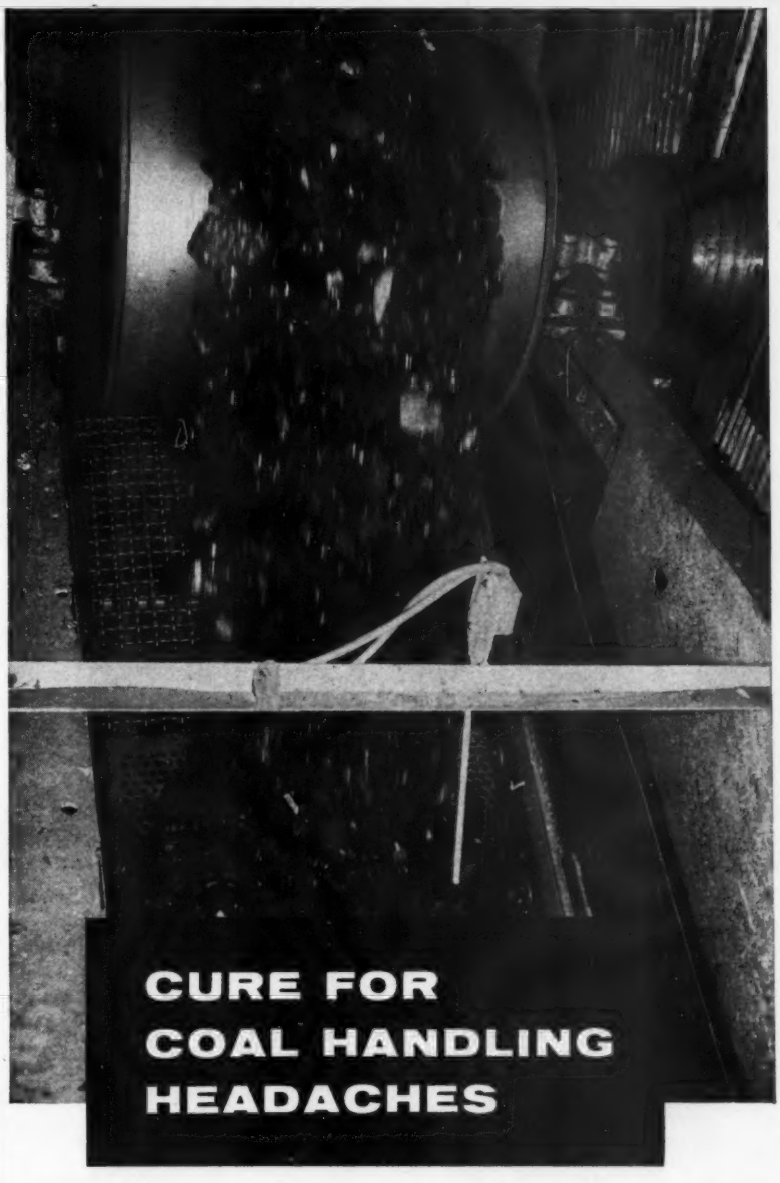
The corporation plans the construction of a processing mill and auxiliary equipment with work to be started shortly. The corporation owns about 3000 acres south of Fernandina Beach on the island and the mining will be done by a bucket-ladder



dredge which is capable of handling about 500 tons of sand an hour. The sand will be wet concentrated on the dredge and the concentrates moved ashore and trucked to a dry mill where the minerals will be separated by conventional electrostatic and magnetic methods

The titanium-bearing minerals will be shipped to the Ashtabula, Ohio, plant of the Electro Metallurgical Co., a division of Union Carbide, for making titanium sponges.

According to Dial, exploratory drilling during the past two years by Union Carbide Ore Co., a division of the Corporation, has indicated the area contains economically adequate reserves for heavy minerals, including ilmenite, rutile, zircon and monazite.



To get out more coal at less cost, Zeigler Coal & Coke Corporation's Bradbury Mine uses a Hewitt-Robins belt conveyor system. Coal, transferred from 5,000 ft. of panel belts to a 4,000 ft. mainline conveyor system, is discharged to a 42" wide, 950 ft., 16° slope conveyor traveling at 450 FPM. This conveyor delivers 450 TPH to an H-R Vibrex Screen which removes fines ahead of the breaker.

The underground haulage system, including conveyor belts, idlers, and machinery, was designed, engineered, and manufactured by Hewitt-Robins. To find out how H-R products and services can help you, consult your classified telephone directory for the nearest H-R representative, or contact Hewitt-Robins, Stamford, Conn.

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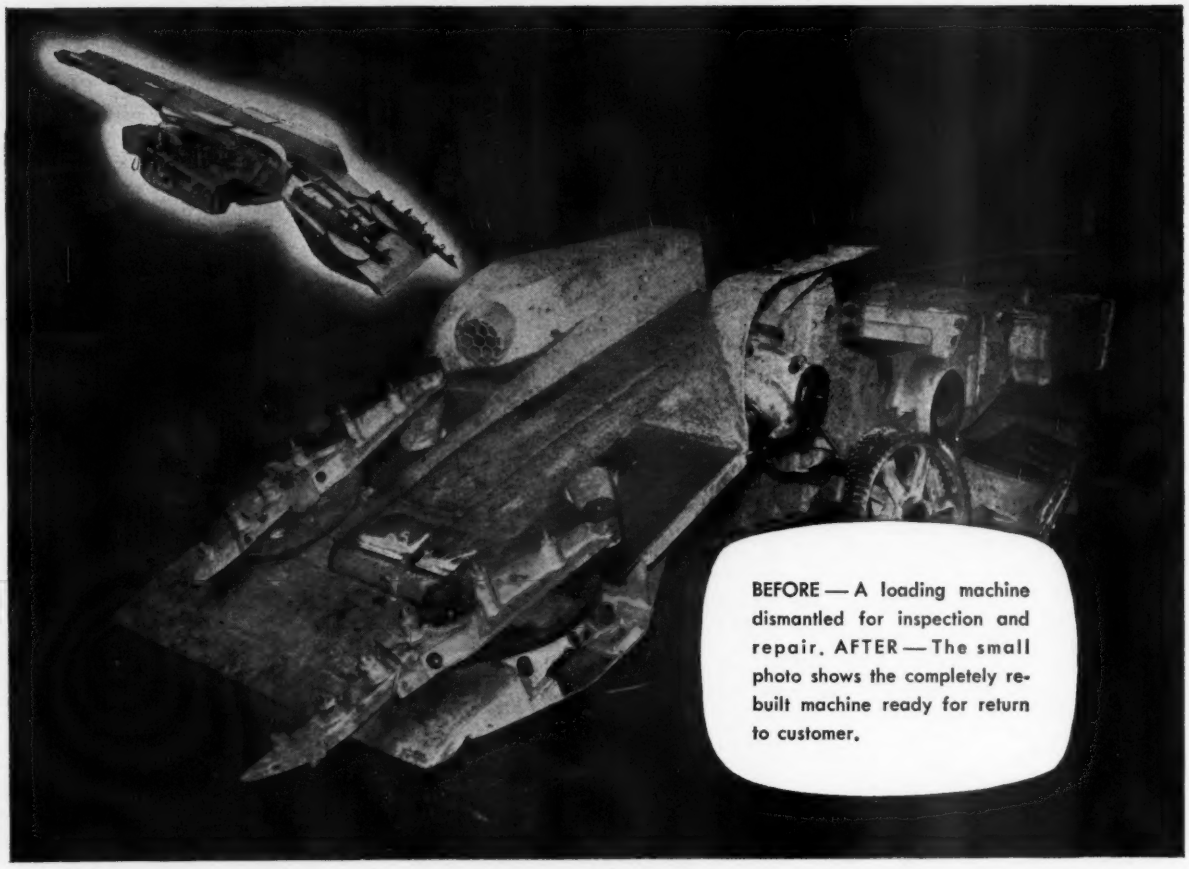
INDUSTRIAL HOSE...VIBRATING CONVEYORS, SCREENS & SHAKEOUTS



BEFORE — A loading machine dismantled for inspection and repair. AFTER — The small photo shows the completely rebuilt machine ready for return to customer.

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Western States

Six Idaho Mining Firms Merge

Six North Idaho mining companies have merged to unite claims for deep development work on virtually the entire western extremity of the north Idaho silver belt.

The Bunker Hill Co. will do the work at the 3000-ft level, tunneling laterally for some 18,000 ft from its Crscent Silver Mine on Big Creek to its workings at Kellogg. The tunnel will cut deep under property now held individually by Altura Mining, Hill Mining & Milling, Mohawk Silver-Lead Mining, Paramount Mines, Yreka Mining and Yreka United.

Some of these properties have been active for more than 50 years, but the companies have not been able to finance deep development work. Yreka United will be the surviving company in the merger, stockholders in the other five being given shares in Yreka United.

Officials of the companies said the merger is necessary because it would be virtually impossible for each firm to negotiate individually with Bunker Hill for deep development in view of problems involved in possible overlapping of ore bodies and uniting of veins far below the surface.

The area involved covers thousands of feet parallel to and immediately north of the big Alhambra fault zone where the Crescent Mine is developing good silver ore at the 3000-ft level. Bunker Hill now takes its Crescent ore to the surface and must truck it some six miles to the mill at Kellogg. When the tunnel is completed, the ore can be brought through underground.

A profit-sharing plan with Bunker Hill is included in the agreement.

Washington Copper Prospects Optioned

The Anaconda Co. has optioned two copper prospects in the Cascades, the company's Northwest exploration office in Spokane, Wash., has announced. Forty claims 2½ miles north of Snoqualmie Pass were optioned from United Cascade Mining Co. of Seattle. Anaconda built an access road to the property from Goldmyer Hot Springs last summer and started a geological survey which will be completed this summer.

Also under option is a ten-claim property 16 miles northeast of North Bend on Quartz Creek, owned by Western States Copper and Uranium Corp. of Seattle.

Lignite Mines Utilized

Lignite formations found in northeast Texas are the source of activated carbon raw material for the Darco Division of Atlas Powder Co. and have resulted in a by-product which attracted White Glove Charcoal Co. to the area.

The lignite, which is being strip mined, is located near Marshall, Texas, and is found 30 to 40 ft below the surface. Between 1932 and 1944, shaft mining was utilized. The average depth of the lignite is ten ft and the stripping cut is 100 ft wide.

Will Move Underground

Great Lakes Carbon Co. is planning to start underground operations at its perlite property south of Socorro, N. M. Surface operations, which have been conducted for the past eight years, will be continued.

Eagle-Picher Closes Plants

About 60 percent of the company's mining and milling operations were closed recently as The Eagle-Picher Co. announced that its zinc mining and milling operations in the Tri-State District were being shut down. Also closed was the company smelter at Henryetta, Okla.

The smelter has a capacity of 125 tons of slab zinc per day and it is estimated that, on a 30-day basis, the shutdown will mean a reduction of about 3700 tons per month.

A company spokesman said that inventories had been increasing in recent months and that steel producers and other consumers have been reducing inventories since late last year. He also said that the price of zinc has not risen to production costs. He said the reason for this is because supply exceeds demand due partly to heavy imports.

No indication was given by company officials as to when operations would be resumed.

Snow Train Moves Supplies

A 35-mile "Snowball Express" has been in use through the winter months by the International Nickel Co., Inc., to get heavy equipment and supplies to the corporation's new mining project in the Myster-Moak Lake area of Canada from the terminal point of the Canadian National Railway.

The trains, made up of diesel-powered tractors and a series of huge sleds, carried 30,000 tons of construction materials for the two mines and related surface plants. With 24 such trains operating on a 24-hour a day schedule, a total of 1000 trips were necessary over the 70-mile round trip shuttle. The round trip required 14 hours and each train was manned by two crews. About 150 men were engaged in the project.

Since time was of the utmost importance because of spring thawing, the trains made the quickest possible time. At the northern end of the run, the tractor was detached from its loaded train and attached to a string of empty sleds for the return journey that started immediately. At the Southern terminus the procedure was reversed and the train returned with supplies and equipment.

Mining Division Organized

Great Lakes Carbon Corp. has consolidated its Dicalite and Perlite Division into the newly organized Mining and Mineral Products Division. The former divisions, as well as the Palos Verdes Stone Department and the Strata Products Department, each have been given the status of departments in the new division.

The Dicalite Department produces filteraids, fillers, insulation and other diatomite materials at four plants in California, Nevada, and Oregon. The Palos Verdes Stone Department quarries natural decorating building stone in southern and central California. Crude perlite ore is mined by the Perlite Department at locations in Colorado and New Mexico; the Strata Products Department, with offices in Houston, Tex., supplies expanded perlite materials to producing segment of the petroleum industry.

Administrative headquarters of the Mining and Mineral Products Division will be located in the company's Los Angeles offices.

Decade of Reserves Seen

American Zinc, Lead & Smelting Company's annual report says its lead-zinc ore reserves in the Metaline, Wash. district are sufficient to keep the Grandview mill running for 10 to 12 years. Production last year totaled 10,567 tons of concentrates.

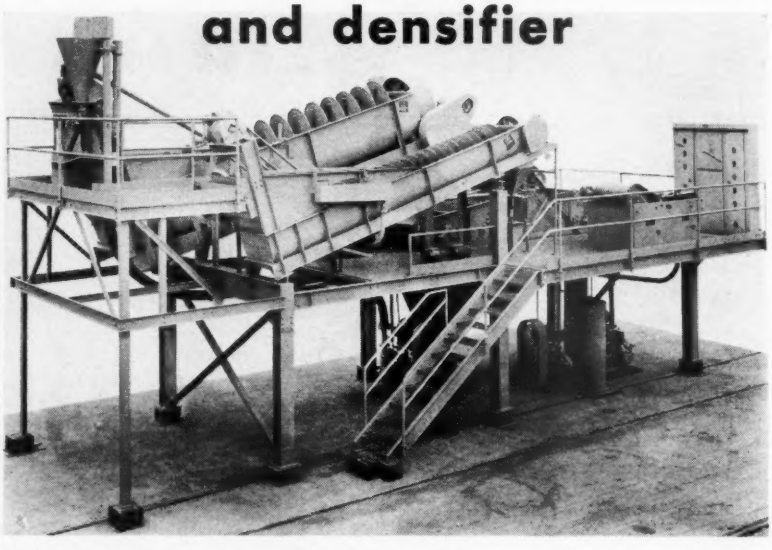
Ore Buying Schedule Changed

The U. S. Atomic Energy Commission, as of May 1, 1957, discontinued the practice of paying for the vanadium content of non-carnotite ores at the Grants, N. M., Government-operated buying station. No change will be made in the schedule for carnotite-type ores, and the producers of such ores will continue to receive payment for the vanadium content as provided in Circular 5, Revised.

In the past, the Commission has issued special contracts providing for payment for vanadium content of non-carnotite ores in cases where the lime content of the ore was sufficiently low to warrant such payment. However, experience has shown that the ores from the vicinity of Grants are in general not of the carnotite-roscoelite type, which usually contains vanadium in a ratio of over five parts V_2O_5 for each part of contained U_3O_8.

The Grants ores are primarily ores containing minor amounts of vanadium which cannot be recovered economically. For this reason, contracts recently entered into by the Commission for construction and operation of uranium processing plants in the vicinity of Grants have not called for the incorporation of vanadium recovery equipment.

Prefabricated HMS plants with AKINS separator and densifier



Typical Akins 3-product HMS installation with Separator and Densifier. Note how Akins tank construction permits simple supporting structure. These Sweco-built plants are compact, simple in design, and convenient.

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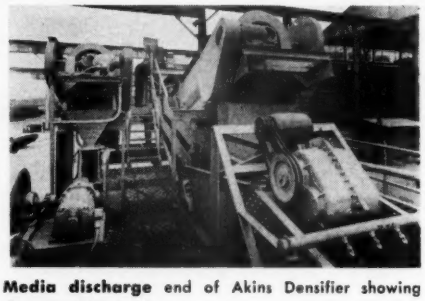
These prefabricated HMS plants are designed, manufactured and erected by the Southwestern Engineering Co., Los Angeles. Akins Separators were selected by Sweco because . . .



Media discharge end of Akins Densifier showing demagnetizing coil.

EXPERIENCE has proved these advantages of Akins

- Gradation of pool density from feed entry point to sink removal point provides natural cleaning of sink, and allows circulation of media at lower gravity and viscosity.
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- Start-up under full load, eliminates necessity of draining vessel after shutdowns.
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Climax Retains Production Title

Climax Molybdenum Co. recently celebrated production of the 100-millionth ton of ore at its Climax mine near Leadville, Colo. At a celebration in honor of the event, the company announced that it is studying plans for construction of a new by-product plant to facilitate recovery of tungsten and tin.

Production at the molybdenum mine of Climax Molybdenum Co., situated on the Continental Divide, Climax, Colo., continued during 1956 to be the largest of any underground mine in North America. The mine produced and the mill treated 9,930,000 tons of ore during the year. Average daily production set a new high of 32,000 tons, and that rate was increased toward the end of the year to 34,000 tons per day.

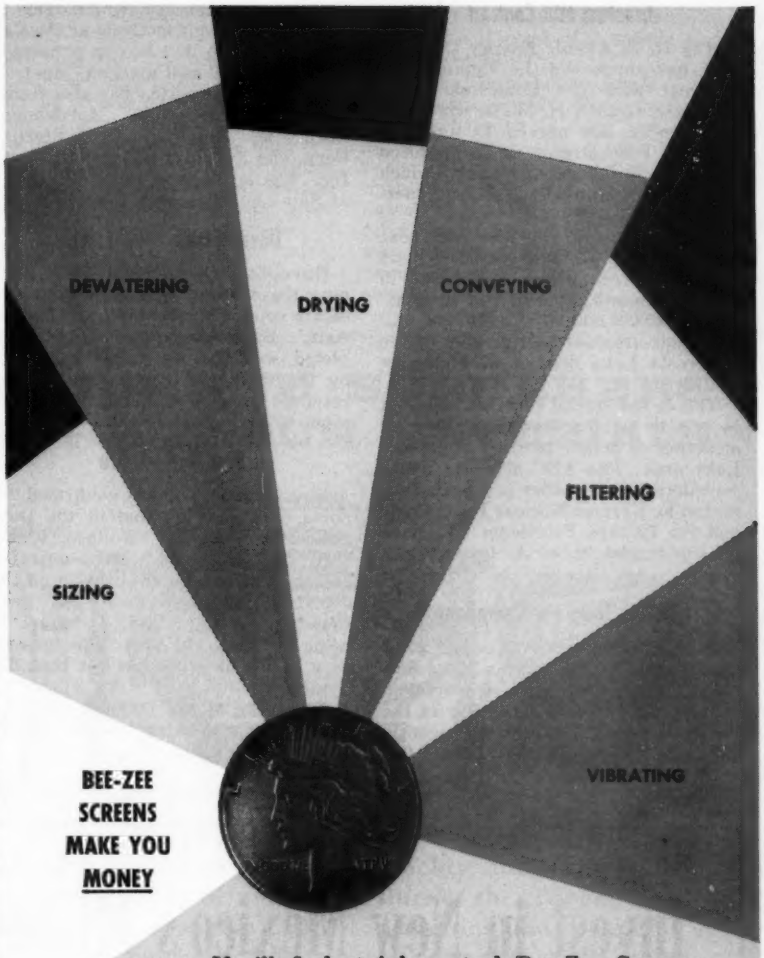
Despite the higher tonnage produced, actual production of molybdenum decreased in 1956 because of lower grade ores. Molybdenum production fell from 43,043,138 lb in 1955 to 37,489,000 lb last year.

Climax is developing a new mine level that should be ready for production in about eight years, when it is anticipated that the upper of the two levels now being mined will have been exhausted.

Expansion of milling facilities continued during 1956, with a new mill of 3500 tpd capacity being installed and placed in operation during the third quarter. Another mill was installed and began production in February 1957. Improvements were also made in secondary crushing facilities.

Dakota Uranium Tested

A test run of South Dakota uraniferous lignite at the AEC pilot plant at Grand Junction, Colo., showed a recovery of 87.5 percent. Jesse Johnson, director of the raw materials division of the AEC, said that cost data gathered in the test runs would be made available to prospective processors.



You'll find stainless steel Bee-Zee Screens everywhere in coal processing operations. They're separating with a precise, almost unbelievable accuracy. They're dewatering with a thoroughness that keeps BTU-counting coal customers happy. They're fitted to every type of equipment . . . electronically precision-welded into every conceivable shape, in every needed dimension.

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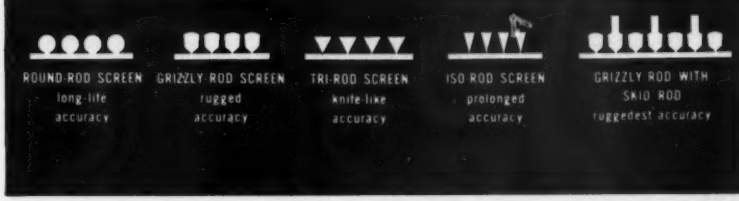


Uranium Mill Contract

The U. S. Atomic Energy Commission has announced the signing of a contract with the Homestake-Sapin Partners, Grants, N. M., in which the Commission has agreed to purchase uranium concentrates to be produced by a new processing mill which Homestake-Sapin will erect and operate in the Grants area.

Construction of the new mill near Bluewater, N. M., is expected to start soon with completion scheduled in about 14 months at a cost of approximately $9,000,000. The 1500 tpd mill will treat uranium-bearing ores of the Ambrosia Lake district of McKinley County, N. M.

This is the second contract executed in recent months involving the construction of a mill to treat Ambrosia Lake ores. The AEC also has under consideration two other proposals submitted by Kermac Nuclear Fuels Corp. and the Phillips Petroleum Co. based on the treatment of Ambrosia Lake ores.

Resume Tungsten Operations

Minerals Engineering Co. and affiliated Salt Lake Tungsten Co., Salt Lake City, have announced reopening of mines, a mill and a refinery in the West. Minerals Engineering recently discovered from 300,000 to 500,000 tons of tungsten ore which may be mined by open-pit methods at the Calvert Creek and Red Button properties near Minerals' mill at Glen, Mont.

Salt Lake Tungsten has also signed sales contracts with Molybdenum Corp. of America, Firth-Sterling Corp. and Sylvania Electric Products, Inc. The latter firm owns 50 percent of Salt Lake Tungsten Co.

Duval Plans Copper Mill

Duval Sulphur & Potash Co. is planning the erection of a 10,000 tpd mill on its copper properties near Tucson, Ariz. Exploration has been completed, and the 65 claims controlled by the firm are said to contain ore reserves of approximately 80,000,000 tons.

New Dayrock Ore

Day Mines, Inc., has confirmed reports of a new ore find in the Dayrock Mine north of Wallace, Idaho. Two diamond drill holes penetrated encouraging ore mineralization on the 500-ft level where none had been found previously, and a tunnel is being driven to the area. The importance of the showing has not been determined.

Deepening of the Dayrock shaft to provide for a working level of 1250-ft horizon is nearing completion.

Idaho Mine Safety Awards

The State of Idaho has announced safety awards to four mining firms for the best safety record of 1956. The awards went to the Calera Mining Co. in Lemhi County for the best safety record and to the Hecla Company's Star Mine in Shoshone County for the most improved safety record for mines which work more than 250,000 man-hours per year.

For smaller mines, an award was given to Hecla's Silver Mountain project for the best safety record and the Day Mines, Inc., Hercules mine in Shoshone County for the most improvement.

New Labrador Project

Proposed development of a billion tons of iron ore in Labrador was announced recently by Premier Joseph Smallwood. Further details as to the development will be announced in the near future.

Premier Smallwood said 27 lawyers have been working out final agreements, but declined to give any further details. It is believed that those participating in the project are Newfoundland-Labrador Corp., Canadian Javelin Ltd., Pickands-Mather & Co., Harriman-Ripley Co., and the Newfoundland government.

Invest in New Mexico's Mining Industry

• • • New Mexico has 68% of the nation's known uranium reserves, according to the U. S. Atomic Energy Commission.

• • • Minerals are already New Mexico's largest industry.

• • • YET, millions of acres of the state's vast expanses are available for development, are totally unexplored, and offer rich inducement to investment.

• • • The State of New Mexico invites your interest and offers every assistance possible.

• • • Our Staff Geologist and Engineer is available to help you with consultations, conferences and inspection tours.

For additional information write:
Berl Huffman, Executive Director
New Mexico Economic Development Commission
P. O. Box 706, Santa Fe, New Mexico

N. M. Discovery Law Changed

The State of New Mexico has adopted a law authorizing acceptance of drill holes as evidence of discovery of minerals on a mining claim. Drill holes must be at least one and one-half in. in diameter.

Bauxite Discovery in Hawaii

Stanford Research Institute reports that Hawaii has an estimated 600,000,000 tons of bauxite, or more than 10 times the known U. S. mainland reserves. According to the report, the 300 sq miles of deposits on the Island of Hawaii alone are enough to supply the United States, at present consumption rates, for 100 years. The Hawaiian deposits are believed to be as good, and in some cases better, than ores on the mainland and those being imported at this time.

Dedicate Peru Power Facilities

Switches were thrown recently putting into operation Cerro de Pasco Corporation's new $25,000,000 Paucartambo 72,000 kva hydro-electric power production and transmission facilities high in the Peruvian Andes. Taking part in the ceremony were Robert Koenig, president of Cerro de Pasco; Carlos Alzamora, Peruvian Minister of Labor; Victor Ricaldi, senior Cerro de Pasco employe at the project and the Rev. Prospero Reyes, Vicar of Cerro de Pasco, one of Peru's oldest Andean mining communities.

The power will be used at Cerro de Pasco's smelting and refining center at La Oroya and will enable the company to expand zinc production from a current daily rate of 120 tons of slab zinc to 150 tons by the end of 1957. Company officials expect to reach an anticipated peak level of 240 tons daily or approximately 87,000 tons per year.

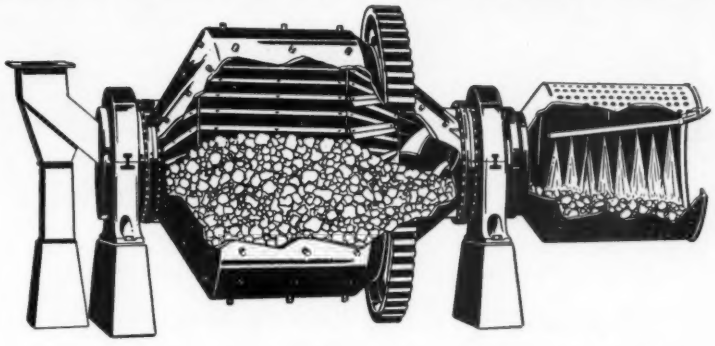
The Paucartambo project was begun in 1951 and includes an 89-mile, 138,000-volt transmission line. The Paucartambo River has been dammed at a site in the Paucartambo Valley known as Yuncan and from this headworks the water is diverted into an eight-mile tunnel through the mountains and is charged down a 3800-ft steel penstock to the power station. The station is located 11 miles downstream from the dam and houses three generators, each rated 24,000 kva. It is possible that a fourth and perhaps a fifth generating unit may be added to present facilities.

To supplement water from the Paucartambo River during the dry season, water is also diverted into the main tunnel from the Manto River by means of a concrete arch dam, a diversion tunnel and a connecting raise. Plans are also under way to divert a second river into the reservoir.

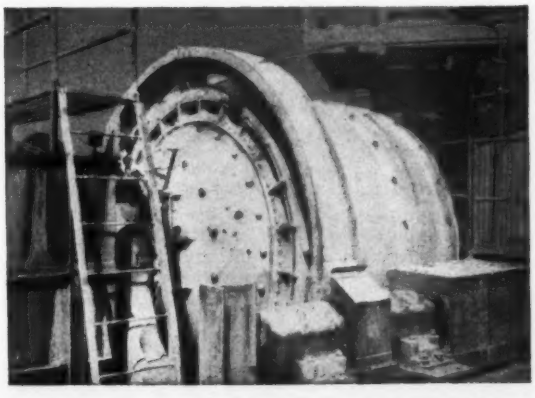
Referring to Paucartambo's 65-mile access road, built by Cerro de Pasco at a cost of $5,000,000, Mr. Koenig said: "Today we make a symbolic contribution to the highway system of Peru of the new Carhuamayo-Yaupi highway. Here at the easternmost end of that road, rises the new Paucartambo hydroelectric plant, tangible proof that when human and material resources are joined with modern technology, nature's frontiers can be made to give way in the interest of economic and social betterment."

At Yaupi Bajo, headquarters of the Paucartambo project, Cerro de Pasco has established a 12-room hotel, dining hall, residences and other facilities. The present population of the community consists of 25 Cerro de Pasco employes and their families. If future plans materialize, Yaupi Bajo may become a vacation and recreational center for Cerro de Pasco employes and their families.

HARDINGE SCRUBBERS FOR PIT-RUN MATERIALS



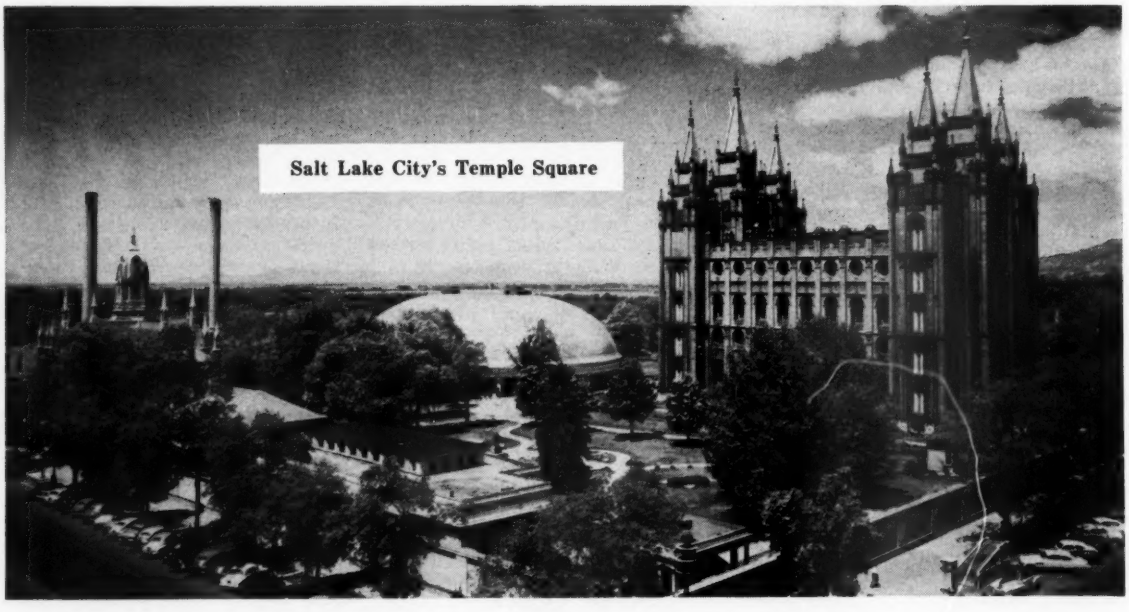
Large diameter, short length trunnions permit chute feeding of unsized ore and rock at rates up to 600 tons per hour.
The mass loading and ball-mill action in the scrubber quickly and completely slurries the clay and dirt, permitting ready separation on washing screens or trommels.



View of a 10′ x 66″ Hardinge Scrubber cleaning crushed dolomite in a California plant.

Ask for Bulletin 37-B-52.

HARDINGE
COMPANY, INCORPORATED
YORK, PENNSYLVANIA • 240 Arch St. • Main Office and Works
New York • Toronto • Chicago • Hibbing • Houston • Salt Lake City • San Francisco



Salt Lake City's Temple Square

METAL MINING—INDUSTRIAL MINERALS CONVENTION

September 9-11, Salt Lake City—at the center of Western mining—will be time and site of the 1957 Western meeting of the American Mining Congress.

Anticipating another fine Mining Congress Convention in September, mining men and women of Salt Lake City have been busy rounding out all arrangements to make it the most worthwhile and enjoyable mining meeting of the year. The several committee chairmen, under the leadership of L. F. Pett of Kennecott's Utah Copper Division, Chairman of the AMC Western Division have called a series of committee meetings and made real progress in finalizing these plans.

Dates for convention sessions are Monday, Tuesday, and Wednesday, September 9, 10, and 11, and trips to some of the Salt Lake area's mining and metallurgical plants will be made on Thursday, September 12.

On Sunday, October 9, registration will be conducted for both men and ladies at the Newhouse and Utah Hotels. Beginning Monday, September 9, the men's registration will be at the Newhouse, while ladies headquarters will be on the Mezzanine Floor of the Utah. The convention sessions will be held at the Newhouse Hotel.

State Chairman of the program committee, answering the call of National Chairman A. H. Shoemaker of Homestake, recently met in Salt Lake City to outline plans for the various sessions. A program of broad scope has been mapped out, to air the industry's major problems—economic, legislative and operative—with outstanding leaders from government and industry taking part.

Time for Relaxation

Entertainment features of the convention will include, first, a Welcoming Luncheon, for both men and women, Monday noon. On Monday evening a Miners Jamboree, with dinner, dancing, and special entertainment will be held at Saltair, Salt Lake's recently modernized amusement park. Kennecott Copper Corp. will be host on Tuesday night at a special party at the 1090 level of the Utah Copper open pit at Bingham Canyon. The Annual Banquet on Wednesday night will again be a "speechless" event with entertainment and good fun for all.

For the ladies there will be a Luncheon and Fashion Show in the beautiful new Union Building on the University of Utah campus on Tuesday, and a "Brunch" at the Salt Lake Country Club and Fort Douglas Golf Club on Wednesday, followed by a special organ recital by Alexander Schreiner at the famous Mormon Tabernacle.

The Geneva Steel Plant of Columbia-Geneva Steel Division, U. S. Steel Corp., near Provo will be shown to convention-goers during a three-hour inspection trip through this largest Western steel works. A number of the major plants in the Salt Lake Valley will be viewed by others on a "circle tour" to take in the Vitro Uranium Plant, Salt Lake Tungsten Plant, U. S. Smelting's Lark Mine, Hercules Powder Plant at Baccus, Kennecott's power plant, mills and refinery, the Garfield Smelter of American Smelting and Refining Co., Western Phosphate Co. and Morton Salt Co. plants, and the Utah Power and Light Company's Gadsby plant. This trip will include stops at the Lark Mine for a trip underground and luncheon, at the Magna or Arthur mill of Kennecott Copper, and at the Gadsby plant.

Arrangements can also be made for those wishing to drive to Moab, Utah to visit uranium mining and milling operations in that vicinity.

The Housing Committee reports that reservations have been pouring in and that hotel rooms will be difficult to procure if reservation forms are not sent in promptly. These should be addressed to the AMC Housing Bureau, Convention and Visitors Bureau, P. O. Box 329, Salt Lake City, Utah.

To Open Geological Office

Hecla Mining Co., Wallace, Idaho, is planning to move its geological headquarters to Spokane in a move to expand its investigation of mining properties, president L. J. Randall has announced to stockholders.

Randall also announced that Hecla has contracted to explore and develop the old Livingston Mine of Idaho Custer Silver-Lead Mines, Inc., near Challis, Idaho. Hecla will deepen the Livingston shaft 250 ft and do 800 ft of crosscutting and drifting and 2300 ft of diamond drilling on the 2500-level and a new 2750-level.

To Use New Mexico Coal

Kaiser Steel Corp. officials have announced plans for the use of coal from New Mexico's Raton District at the company's Fontana, Calif., steel plant by mid-1958.

In 1955 Kaiser acquired a considerable acreage of coal lands to increase reserves of the Fontana operation.

A modernization program has been undertaken at the Kohler mine and considerable drilling has been done on land held in reserve.

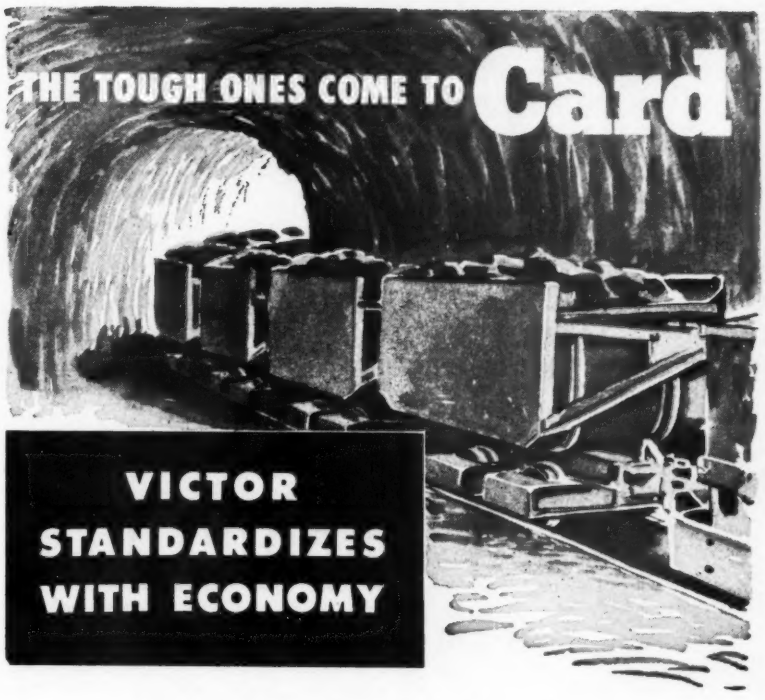
Lucky Seven Makes Plans

M. F. Thacker, manager of the Lucky Seven Mining Corp. of Denver, Colo., has announced that the first of five mills which the corporation plans to locate in Clear Creek and Gilpin Counties has arrived and is being installed at Idaho Springs. Lucky Seven's program, he said, is to mill ore from their own properties as well as to custom mill for other operators.

Set Smelter Safety Record

Employes of the Hurley, N. M., smelter of Chino Mines Division, Kennecott Copper Corp., have set a new safety record. The smelter recently completed 152 days of work without a lost-time accident, bettering the previous mark of 126 days. A minor accident snapped the new record-breaking streak.

Smelter employes were given a special "safety stock dividend" in the form of a merchandise order in recognition of the record.

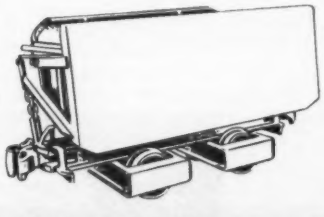


VICTOR STANDARDIZES WITH ECONOMY

The Maiden Rock Mine of Victor Chemical Works first started using Card cars in 1950. Chosen design was a Granby type car of 57 cu. ft. capacity built on 24" gauge and featuring coil spring suspension. The phosphate rock being handled is relatively clean to handle, and the car design is unusually well suited. As a result, not a single Card car has ever had any significant repairs although some wheels have been replaced. Fifty-two of these cars are now in service, representing several re-orders over a four-year period.

Much of the haulage at Maiden Rock is underground, and many of these Card cars seldom see the light of day. The steady day in, day out service record of the cars has meant high production with remarkable economy for Victor—one of the three largest producers of elemental phosphorus.

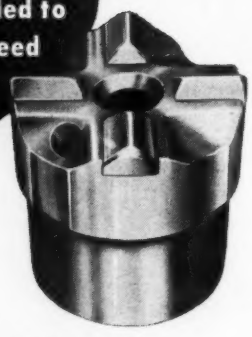
Standardize your haulage with an economical Card design. Our engineers can furnish an efficient car to meet your most difficult specifications.



C.S. Card Iron Works Co.

2501 WEST 16th AVE.
DENVER COLORADO

Exclusive . . . a tungsten carbide insert bit "drilled to destruction without the need of resharpening."



LOWER FIRST COST
LOWER COST PER FOOT DRILLED

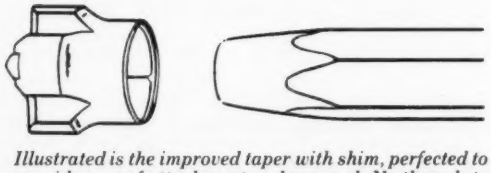
Forged from special alloy steel for strength and toughness

LIDDICOAT
TEE CEE BIT

Liddicoat – pioneer in the development and manufacture of the single-use steel bit – now after years of experience and research, has developed a tungsten carbide-insert bit that completely revolutionizes drilling with carbide bits.

The new Liddicoat TEE CEE bit (Patents applied for) is "drilled to destruction without the necessity of resharpening." Even when dulled, a reverse taper does not occur. In the conventional multi-use carbide bit, a reverse taper stops drilling. The four-point bit permits fast collaring, fast cutting, and easy removal from the hole. New lower first cost and lower cost per foot of hole drilled.

TAPER SOCKET . . . NO THREADS
FIRM, FAST ATTACHMENT



Illustrated is the improved taper with shim, perfected to provide ease of attachment and removal. No threads to strip; longer rod life.

WESTERN
Rock Bit Manufacturing Company
552 West 7th South • Salt Lake City 1 Utah

New Engineering College

The first new private college of science and engineering established in the United States for more than 20 years will open its doors to students next September. To be known as Harvey Mudd College, in honor of the late Harvey Mudd, it will make joint use of facilities of the four colleges now established in Claremont, Calif.

Construction has been started on the first of four dormitories, and the new college will eventually install all needed facilities. Dr. Joseph B. Platt, who will head the institution, said its curriculum will place substantially greater emphasis on social sciences and the humanities than do most large science and engineering schools.

New Mexico Cement Plant

Ideal Cement Co., Denver, Colo., will construct a cement plant east of Albuquerque, N. M. The company has owned limestone deposits a few miles east of Albuquerque for many years, and for several months engineering studies of the site have been under way.

Plans call for the erection of a plant with capacity of 1,000,000 bbls of cement annually; this may be increased, when the added capacity is needed, up to 2,000,000 bbls.

Granby Slates Open Pit Work

Granby Consolidated Mining, Smelting & Power Co., Ltd., is planning to go into production this summer at the old Phoenix Mine near Greenwood, B. C., Canada. An exploration program started in 1955 has disclosed ore reserves of more than 1,000,000 tons grading about one percent copper in one area and 379,800 tons with a copper content of 0.92 percent in another area.

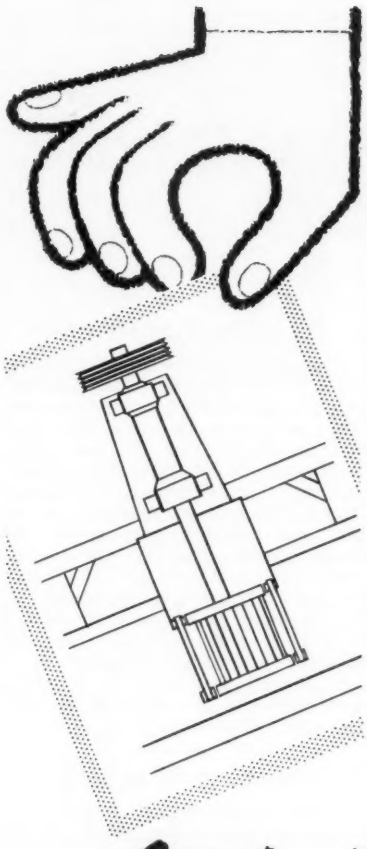
Mining will be open-pit, and more than 25,000 cu yd of overburden have already been removed. Camp buildings have been constructed and an excavation made for a 700 tpd concentrator.

Utah Potash Potential

Delhi-Taylor Oil Corp. has established reserves of some 10,000,000 "proved and probable" tons of potash in the Seven Mile Anticline area immediately north of Moab, Grand County, Utah.

Delhi-Taylor has completed a preliminary shaft pilot hole to a depth of 611 ft and a second such hole will be sunk in studies preparatory to shaft sinking.

A domestic market survey for potash indicates, the company reports, "a favorable situation and that with a vigorous sales program it can expect to obtain its share of the domestic market." Rail freight rates have not yet been set.



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WEMCO

FAGERGREN FLOTATION MACHINES

are chosen most often when competitive tests are run, because of ***savings in manpower, floor space, reagents, horsepower as well as superiority in metallurgical results.***

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Offices and representatives in principal cities of the United States and Canada and in major countries throughout the world.

AMC COAL SHOW REPORT

(Continued from page 96)

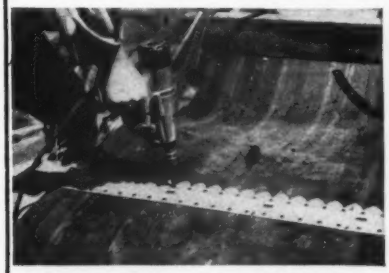
from the bottom of the present shaft, going down an additional 360 ft and installing a belt conveyor. The conveyor tunnel was sunk on an 18° slope in two roughly equal legs totaling 1388 ft. The methods of sinking, the construction of the conveyor, and the design layout were covered in detail. The new level is now under development, and uninterrupted future production is assured.

"Production of High Early Strength Cement in Single Stage Ball Mills" was the subject of the next paper presented by C. A. Rowland, processing machinery department, Allis-Chalmers Manufacturing Co. In recent years it has been possible to grind clinker for high early strength cement in a single stage ball mill circuit as opposed to compartment mills or stage grinding circuits used formerly. At present both types of circuits are being used and the purpose of Rowland's paper was to present his findings as to the comparative merits of each. Since the use of single stage mills involves economic savings such as lower equipment costs, lower building costs, and less space requirements, it is to advantage to use the short mills where they will do as good a job as the compartment mills —depending upon local conditions, equipment already installed, etc. Rowland presented the results of information gathered from 16 cement producers showing their preferences and the specific characteristics of each plant.

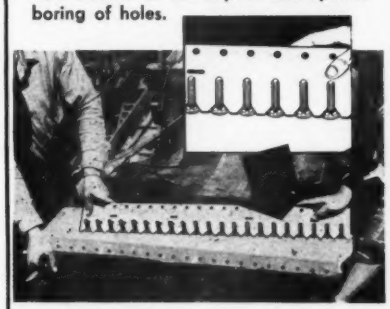
C. V. O. Hughes, assistant manager, Virginia-Carolina Chemical Co., spoke on "Hydraulic Transportation of Phosphate Ore" as practiced at the phosphate operations in Poke and Hillsborough Counties in central Florida. Since it is necessary to transport the material up to five miles from the mining operation to the mill, the cost of moving it is of major importance. Hughes gave a complete picture of the necessary components for hydraulic transportation and included a reasonably conservative estimate of probable average costs. The cost figures given by Hughes, which were typical, but not actual, show that the material could be moved by pumping a distance of two miles for a total cost of 6.9 cents per ton. This breaks down to 2.7 cents for transportation, 3.2 cents for pumping, and 1.0 cent for pipeline. The keys to good hydraulic transportation, he said, are maintaining maximum percent solids and minimum velocity commensurate with good pipeline operation. In any case hydraulic transportation has a definite place in modern mining.

NEW FLEXCO POWER TOOLS CUT APPLICATION TIME IN HALF

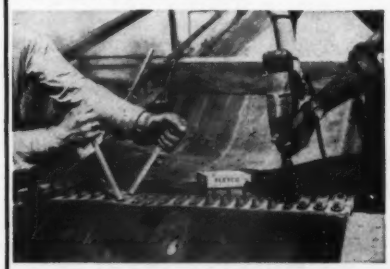
Your two man belt team can now join a belt 30" wide in 15 to 20 minutes . . . using the new FLEXCO Power Tools.



The FLEXCO Power Tool Boring Bit used with electric or air impact tool speeds boring of holes.



New FLEXCO Templet positions bolts for quick joining of belts. Reaching under belt has been eliminated.



Running down nuts is fast with the new FLEXCO Power Wrench used with electric or air impact tool. Two Bolt Breakers are used together to complete the joint.

If you are interested in speeding up fastener application, order the new Power Tools from your local FLEXCO Distributor. Write for Bulletin F-112-A.

FLEXIBLE STEEL LACING CO.

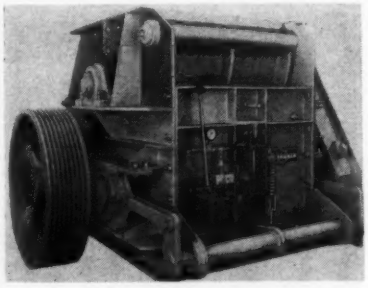
4675 Lexington Street • Chicago 44, Illinois

Manufacturers Forum

Coal Crusher

A TWO-STAGE coal crusher has been developed by McLanahan and Stone Corp., Hollidaysburg, Pa. The McLanahan Black-Diamond Triple-Roll Crusher reportedly was developed to receive run-of-mine coal or direct open pit feed and reduce it to as small as ½ in. size.

The crusher is composed of two elements—an 18 in. diameter single



roll crushing primary feed against a curved crushing plate, and two 18 in. diameter rolls performing the secondary reduction below.

A hydraulic system positions the secondary crushing rolls to any desired opening up to six in., with roll openings indicated by gauge. An adjustable relief valve in the hydraulic system protects against damage to the secondary crushing system from uncrushable materials, and the primary system is protected from tramp iron damage by breaking blocks.

The unit is made in four sizes—18 in. roll diameter by 24 in. roll width, 18 by 36 in., 18 by 48 in., and 18 by 60 in.

D-C Motors and Generators

NEW VENTILATING SYSTEM, improved commutating ability, and reduced armature inertia are claimed for this line of d-c industrial motors and generators known as the Life-Line H series. Now in production, the motors and generators have drip-proof enclosures as standard and bear NEMA class B ratings. They span motor ratings from 1 to 150 hp and generator ratings from ¾ to 100 kw.

Additional information may be obtained from Westinghouse Electric Corp., P. O. Box 2278, Pittsburgh, Pa.

Inquiries about new equipment appearing in Manufacturers Forum are welcomed. For additional information on any piece of equipment in this section write directly to the manufacturer, or to Mining Congress Journal with name of item and date of issue in which it appeared.

Industrial Air Compressor

THE LARGEST PACKAGE-TYPE compressor available, according to the manufacturer's report, the WN-224 is in the 350 to 1000-hp range. Output at 80-125 psig is rated from 2418 to 6048 cfm, depending on motor horsepower. The compressor is a four-cylinder, double-acting, water-cooled machine of semi-radial design, achieving final pressure in two stages.

Three standard single models and three Twin Unit models are available, plus corresponding altitude sizes. Twin units consist of two standard compressors powered by one motor. High and low pressure variations of the compressor are also available.

More information may be obtained from Joy Manufacturing Co., Oliver Bldg., Pittsburgh, Pa.

Portable Sump Pump

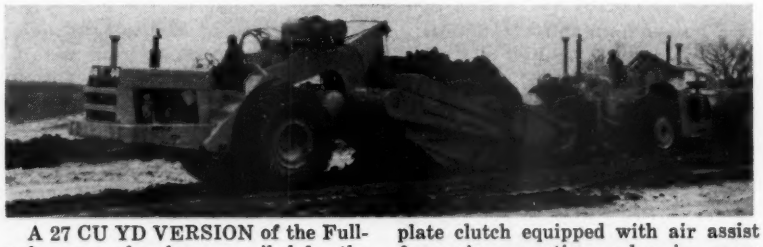
THIS SELF-CONTAINED portable sump pump requires no priming. The pump body, impeller, and strainer are made of bronze, to resist corrosion and to insure spark-free operation. Heavy duty thrust and radial bearings support the two-part, non-clogging impeller, which is mounted on a stainless steel shaft, according to the manufacturer. Bearings are double-sealed to protect them and the air motor from contamination or damage by dirt or corrosive liquids. The pump is 19⅜ in. high and reportedly can pass through a 9 by 11-in. hole.

Additional data may be obtained from Schramm, Inc., 900 East Virginia Ave., West Chester, Pa.

Diamond Core Drill

CRADLE MOUNTED on an air leg for short hole underground coring, this diamond core drill has been introduced by the E. J. Longyear Co., Minneapolis 2, Minn. The Hi-Speed Air Leg Diamond Drill can be operated by one man and requires no spraying or bracing, according to the company. As drilling proceeds, the Air Leg advances the string of drill rods into the hole. Standard E or XRT Rods are used. The drill is powered by a 10 hp, 3000 rpm air motor, and has a rated capacity of 60 ft of E Rod.

Scraper

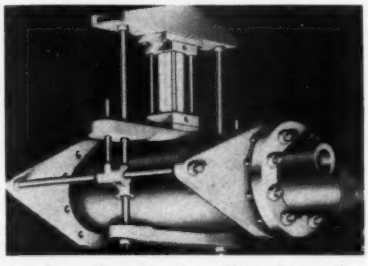


A 27 CU YD VERSION of the Full-pak scraper has been unveiled for the LeT-WesCo Model B Tournapull. In addition to the scraper, the Tournapull prime mover has been restyled. The combination is said to have more than 50 "under the skin" improvements over the previous Model B. Mechanical advances claimed include tougher, longer wearing 16 in. double-plate clutch equipped with air assist for easier operation; a heavier, more rugged final drive shaft; and a constant voltage transformer and new rectifier in the electric power system which provides high output even at low engine rpm.

For further information contact LeTourneau-Westinghouse Co., Peoria, Ill.

Pinch Valve

NEW MODELS of the Massco-Grigsby Pinch Valve incorporate several improvements of value on mining industry applications, according to the manufacturer, The Mine and



Smelter Supply Co., 3800 Race St., Denver, Colo. The valve has been used for many years for handling abrasive and corrosive pulps and liquids. It is available with either rubber or neoprene sleeves, in sizes from 1 to 14 in. inside diameter, for pressures to 150 psi and temperatures to 200°.

An outstanding new feature is said to be the Hydral-Air operating mechanism for closing of valve. It consists of an air-hydraulic pump and can be installed as a centralized unit for operating several valves. It can also be equipped for automatic regulation where it is essential to control liquid level in tanks or the rate of flow in pipe lines.

Other new type operating mechanisms claimed include a torque arm reducer for manual operation and a motorized unit. Remote control is possible on all three types of mechanisms when the valve has to be located in inaccessible places.

Field Range Finder

FOR MEASURING DISTANCES from 8 to 100 ft, the Range Finder has a six-in. base. Operation is based on coincidence of two images—one image is seen in its natural color and the other image is seen in a strongly contrasted gold color. Upon sighting through the eyepiece both images will

be seen. By turning the knob the white image will move either toward or away from the gold image. Knob is turned until the two images coincide. When this occurs Range Finder is in perfect alignment, and the operator reads distance to the object sighted on dial. Accuracy is assured within two percent, according to Edmund Scientific Co., Barrington 25, N. J.

Announcements

Richard W. English has been elected president of **Victaulic Co. of America**, succeeding **M. C. Hutchinson**, who has been named chairman.

F. X. Costanzo is elected to vice-president, Eastern Sales Division.

Vincent N. Burnhart, operations manager, has been appointed general manager of the **E. J. Longyear Co.**, succeeding **Wesley Davenport.** Davenport, who has been a vice-president of Longyear since 1950 and a director since 1940 will assume the position of chairman of the Planning Committee, where he will be responsible for preparing long range plans for the company and its world-wide subsidiaries.

Kurt Allan Belfrage, former Swedish diplomat and deputy managing director of **Atlas Copco AB** of Stockholm, Sweden, has been named managing director of the Atlas Copco Group of companies. Belfrage succeeds **Walter Wehtje** who retired April 13 after 17 years as managing director.

Election of two new vice-presidents by the **Thor Power Tool Co.**, has been announced.

James A. Lind was named vice-president, finance, and will continue in his present post of treasurer as well.

John F. Corkery, formerly sales promotion manager, was appointed vice-president, public relations. He will be in charge of public relations, advertising and sales promotion.

Gordon N. Dow has been appointed general sales manager of **Leschen Wire Rope Division, H. K. Porter Co., Inc.**

Don S. Permar has been named to the newly created position of assistant general sales manager for the **Le Roi Division, Westinghouse Air Brake Co.**

The election of **Leo B. Kelly, Jr.**, as vice-president of **Penn Machine Co.**, has been announced. In addition to his new position, Kelly will continue to serve as secretary and treasurer.

Four new officers of **Marion Power Shovel Co.**, a division of the Universal Marion Corp., were announced by Universal's board of directors at the parent company's annual meeting.

Robert Campello, formerly general sales manager, and **Martin R. Tuttle**, previously general works manager, were elected vice-presidents. **William R. LeMasters** was promoted from treasurer to secretary and treasurer, and **David Reich** was elected assistant to the president.

Recently **Pickard Industries, Inc.** was organized to take over operations of the **Central Mine Supply Co.** and the **Tamping Bag Co.**, Mt. Vernon, Ill. There will be no change in personnel, the only difference being that the company is now operated as a corporation instead of a partnership.

CATALOGS & BULLETINS

DO'S AND DON'TS FOR DIAMOND DRILLING. *Joy Manufacturing Co., Henry W. Oliver Bldg., Pittsburgh 22, Pa.* Second edition of a helpful handbook on diamond core drilling, Bulletin D-38 sets forth basic techniques which apply to all diamond drilling. The 200-plus operating tips listed in the booklet range from care of bits to use of wrenches. In addition, there are sections on diamond bit recommendations for various geological formations and general information about diamonds.

DUAL-FLOW ROTARY DRYER. *Carpo Manufacturing, Inc., Jacksonville 6, Fla.* A single sheet bulletin, RDB-101, gives design, construction and other important details of the dual-flow rotary dryer. Bulletin describes two models—the small RD-1020 dryer, capable of evaporating 200 lb of water per hour, and the larger RD 1430 dryer, capable of evaporating 400 lb of water per hour.

GUIDE TO SELECTION OF IMPERVIOUS GRAPHITE. *National Carbon Co., 30 East 42nd St., New York 17, N. Y.* Recommendations for the application of Karbate impervious graphite and National resin base cements in corrosive service are presented in catalog section S-5050.

REAR-DUMPS. *Euclid Division, General Motors Corp., Cleveland 17, Ohio.* Euclid has published descriptive literature on four rear-dump models that are now in production. These bulletins contain specifications on the following units: Model S-7 which is an overhung engine type tractor with semi-trailer of 12 ton payload capacity; Model S-18, a semi-trailer with rated payload of 35 tons and heaped capacity of 32 yd.; Model R-18, a conventional type hauler of 18 ton capacity; Model R-40, a tandem-axle machine powered by two engines (total of 470 or 500 hp) with separate Torqmatic Drives for each axle—capacity, 40 tons.

(Continued on page 132)

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PINCH VALVES. *The Mine & Smelter Supply Co., 3800 Race St., Denver, Colo.* This ten-page folder on Massco-Grigsby Rubber and Neoprene Pinch Valves for corrosive and abrasive pulps and liquids gives engineering specifications and data on service recommendations in the mining industry.

MOTOR SCRAPER. *Construction Machinery Division, Allis-Chalmers Mfg. Co., Milwaukee, Wis.* Design, engineering, construction and operating features of the Allis-Chalmers TS-360, 20 cu yd motor scraper are described in this 16-p. illustrated catalog (MS-1104).

PIPE DATA. *The Babcock & Wilcox Co., Tubular Products Division, Beaver Falls, Pa.* Known as TDC-138, the data folder contains two tables. One table lists dimensional data for 16 sizes of pipe from ⅛ to 8 in. nominal size for six different weight schedules showing OD, ID, wall thickness, and weights per ft. The other table covers ASTM, ASME Specifications, showing title, grade, type, and analysis for various carbon, alloy, and stainless steel pipe used for high temperature, high pressure and other services.

PRODUCT & WAREHOUSE CATALOGUE. *Engineering Service Dept., Crucible Steel Company of America, Box 1558, Pittsburgh 30, Pa.* Designed for purchasing agents and steel users, the 232-page catalogue describes over 700 products available from stock at Crucible warehouses located throughout the country. The book index lists 16 categories of special purpose steels, including high speed, tool, stainless, alloy and machinery, available in 16,000 grades and sizes. Over 20 estimating conversions and weight tables are included. A copy of the catalogue may be obtained by sending a request on company letterhead.

ROAD EQUIPMENT. *Huber-Warco Co., Marion, Ohio.* Bulletin No. HWC 541 describes in detail each of Huber-Warco's motor graders, tandem roller, three-wheel rollers and the maintainer.

SURFACE ACTIVE AGENTS. *American Cyanamid Co., Manufacturers Chemicals Dept., 30 Rockefeller Plaza, New York 20, N. Y.* This bulletin gives technical data on the seven types of Aerosol surface agents offered in commercial quantities by Cyanamid, including their use in basic formulations, data for testing effectiveness and information on storage and handling.

MOTIVE-POWER BATTERIES. *Exide Industrial Div., The Electric Storage Battery Co., Box 8109, Philadelphia 1, Pa.* Form 5161, "Exide-Ironclad Batteries with Silvium for Motive Power Service," is a revision of a reference catalog on motive-power batteries and discusses new features of the company's batteries used in electric industrial trucks and mine vehicles. The illustrated catalog contains characteristic curves showing battery performance at various discharge rates, a list of user benefits, advantages of Silvium which now forms the positive grid spines of all Exide-Ironclads, and reproductions of actual service records.

MAGNETIC SEPARATOR. *Carpco Manufacturing, Inc., Jacksonville 6, Fla.* Design, capacity and application details for the Model M12 high intensity induced roll electro-magnetic separator are covered in Bulletin No. MB-103. Also covered is a kit for converting Model M12 to a lift type separator.

WELDING. *All-State Welding Alloys Co., Inc., 249-55 Ferris Ave., White Plains, N. Y.* A new manual—52 pp., 4 by 7 in.—is a handy pocket encyclopedia of practical know-how needed by operating personnel, particularly in the maintenance departments of industry and in welding shops where the variety of metal work is non-routine. Scope of the manual is all methods of metal joinery usual to the welding shop plus cutting without oxygen. Single copies are available to operators—up to five copies to supply welder crews or training groups are available when requested by any company or instructor—without charge or obligation. Additional copies may be obtained for 10c each.

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